JOURNAL
OF THE
WASHINGTON ACADEMY OF SCIENCES

VOL. 43 June 1953 No. 6

PALEONTOLOGY.—*The ostracode genus* Hemicythere *and its allies.*

HARBANS S. PURI,[1] Florida Geological Survey. (Communicated by Alfred R. Loeblich, Jr.)

Hemicythere is a common ostracode genus occurring in the Cenozoic of North America; 27 species and a variety have so far been reported from North America, and 23 of these are valid. The genus is of considerable importance because of the stratigraphic significance of its species which could be easily used as excellent markers.

Five species, *H. arenicola* (Cushman), *H. concinna* (Jones), *H. crenulata* (Sars), *H. truitti* Tressler and Smith, and *H. strandentia* Tressler and Smith have been reported from the Atlantic Ocean. Eight species, *H. punctistriata* (Ulrich and Bassler), *H. confragosa* Edwards, *H. minuta* Edwards, *H. laevicula* Edwards, *H. conradi* Howe and McGuirt, *H. sellardsi* Howe and Neill, *H. calhounensis* Smith, and *H. dalli* Howe and Brown, and *H. dalli redbayensis* Howe and Brown have been described from the Miocene of the Gulf Coastal Plain. *H. dalli* and *H. dalli redbayensis* belong to *Cythromorpha* Hirschmann, *H. sellardsi* to *Caudites* Coryell and Fields, and *H. calhounensis* to *Procythereis* Skogsberg. *H. antillea* Van den Bold has been reported from the West Indies Miocene. *H. saginata* Stephenson and *H. amygdala* Stephenson have been reported from the Oligocene *Marginulina-Heterostegina-Discorbis* zones, and *H. kniffeni* Howe and Law from the Mariana Oligocene. Seven species, *H. phrygionia* Howe, *H. lienosa* Howe, *H. cribraria* Howe, *H. bellula* Howe, *H. mota* Howe, *H. aleatoria* Howe, and *H. lemniscata* Howe have been reported from the middle Eocene Avon Park limestone of Florida. Two species, *H. symmetrica* Van den Bold and *H. limbata* (Bosquet), have been reported from the Eocene of the West Indies. To amplify the characters of *Hemicythere* the genus is redescribed and its genotype, *H. villosa* (Sars) figured. A new species, *H. howei*, is described from the Miocene of Western Florida. The exact stratigraphic range of all the species of *Hemicythere* so far reported from North America is shown in the accompanying chart.

HISTORY OF THE GENUS HEMICYTHERE AND ITS ALLIES

The genus *Hemicythere* was proposed by Sars (1925, p. 182) to include a number of species previously referred to *Cythereis* Jones and *Cythere* Müller. Sars placed the genus in an intermediate position between *Cythereis* and *Cythere*; closer in some respects to the latter. Sars did not designate a genotype but instead based the description of *Hemicythere* on eight Recent species from Norway, listed in order: *Cythere villosa* Sars, *Cythereis emarginata* Sars, *C. crenulata* Sars, *C. finmarchia* Sars, *Cythere quadridentata* Baird, *Cythereis angulata* Sars, *Cythere latimarginata* Speyer, *C. concinna* Jones, and *C. oblonga* Brady. As regards the generic characters of the carapace Sars (*op. cit.* p. 182) observed:

> Shell of very solid consistency, calcareous, resembling somewhat in shape that of *Cythere*. Valves more or less unequal, with the surface distinctly pitted or roughly reticulate, marginal zone closely striated, edges densely hairy in front. Hinge with closing teeth well developed. Eyes distinctly separated.

[1] The author expresses his gratitude to Henry V. Howe, director, School of Geology, Louisiana State University, Baton Rouge, for guidance and access to his type collection and library; to Robert O. Vernon, of the Florida Geological Survey, for the use of some of his samples; and to Celia Helena Fajardo for assistance in preparation of plates and manuscript. All types are catalogued in the Henry V. Howe collection, School of Geology, Louisiana State University.

Blake (1933, p. 234) contended that *Hemicythere* be reduced to a subgeneric rank. Its generic nature has been estabilshed by Howe (1935, p. 27), Edwards (1944, p. 517), and subsequent authors. Edwards (*op. cit.*) designated *Cythere villosa* Sars (1865, p. 42)—first of the eight species described by Sars—as genotype.

Skogsberg (1928) divided what he supposed to be the genus *Cythereis* Jones into three subgenera: *Procythereis, Cythereis*, and *Pseudocythereis. Cythereis*, however, as shown by Triebel (1940), is a Cretaceous form. Forms included by Skogsberg under *Procythereis* actually belong to *Hemicythere*. Skogsberg thought it impossible to subdivide the genus "*Cythereis*" on the basis of shape and structure of the shell. He instead based his subgenera on the structure of the appendages and of the penis. Structure of the penis appeared to be more significant to Skogsberg (*op. cit.* p. 16) who thought this organ to have been the "seat of the initial morphological changes leading to speciation." Skogsberg did not give any shell description of the subgenus *Procythereis* since the carapace was broken in most of the specimens examined by him. He recognized two groups—*Torquata* and *Radiata* within *Procythereis*, characterised by "the shape and structure of the penis and by the course of the ductus in the genital verruca of the female." *Procythereis* shows sufficiently distinct characters to deserve a generic rank and is represented by *H. calhounensis* Smith from the Chipola Miocene. Skogsberg's description of the carapace of *Pseudocythereis* is lacking. However, it is clear from the description and figures of the subgenotype, *Cythereis* (*Pseudocythereis*) *spinifera* Skogsberg, that he was dealing with a form closer to *Paracytheretta* Triebel than *Hemicythere*. Forms included under the subgenus *Cythereis* by Skogsberg belong to a new genus and will be described in another paper.

Neviani (1928, pp. 72, 94) described "gruppo" (subgenus) *Auris* under "*Cythereis*". No genotype was designated by Neviani, and his description was based on the following 10 species, all from the Pliocene of Italy: *Cythere speyeri* Brady, *Cythereis* (*Auris*) *subspeyeri* Neviani, *Cypridina similis* Reuss, *Cytherina haueri* Roemer, *Cythere punctata* Münster, *Cythere venus* Seguenza, *Cythereis villosa* Sars, *Cythereis marsupis* Neviani, *Cythereis* (*Auris*) *micrometrica* Neviani, and *Cythereis* (*Auris*) *distinguenda* (new name for *Cythere oblonga* Brady, 1866, *not Cythere oblonga* McCoy, 1844). Neviani's figures appear to be *Hemicythere*, and he even included in *Auris*, *Cythereis villosa* Sars, the genotype of *Hemicythere*. *Auris* is here considered to be a synonym of *Hemicythere*.

The genus *Caudites* was proposed by Coryell and Fields (1937, pp. 10, 11) to include *Hemicythere*-like thick-shelled elongate, subtriangular forms with a thickened anterior rim and additional longitudinal and dorsal ridges. The genotype is *C. medialis* Coryell and Fields. *Hemicythere sellardsi* Howe and Neill belong to this genus. Only five species of this genus are known from North America and their distribution is shown in the accompanying table. A new species, *C. chipolensis* is described from the Chipola Miocene.

Elofson (1941, pp. 288, 289) described *Paracythereis* and *Heterocythereis* as subgenera of "*Cythereis*" (really of *Hemicythere*). The name *Paracytheris* is preoccupied by Jennings (1936, pp. 55, 56) and is therefore invalid. The group Elofson described consists of two species *C. concinna* Jones and *C. latimarginata* Speyer, both of which Sars (1925, pp. 188, 189) considered to be *Hemicythere*. Sars's (*op. cit.*) and Brady's (1868) figures, however, do not agree with Jones's (1857). Since Elofson neither described nor figured the carapace of his subgenotype *C. concinna* Jones, the author does not know for sure which *C. concinna* he referred to. Both of these species are here retained in the genus *Hemicythere* until Elofson's types could be examined. The carapace in *Heterocythereis* is quite similar to that of *Hemicythere* but is relatively thin and smooth. The muscle scar pattern of the subgenotype, *Cythere albomaculata* (Baird), is rather distinctive and consists of a vertical row of five scars, the spots immediately below the top being a pair; in front of the upper end of this row is another oblique row of three smaller scars. *Heterocythereis* is here raised to a generic rank.

Elofson (*op. cit.*) placed under *Eucythereis* Klie (1940) *Cythereis angulata* Sars, *Cythere convexa* Baird, *C. crenulata* Sars, *Cythereis emarginata* Sars, and *C. villosa* Sars. All these species are good *Hemicythere* and since Elofson included in *Eucythereis* even the genotype of *Hemicythere*, *Cythereis villosa*, *Eucythereis* of Elofson is here considered as a synonym of *Hemicythere*.

Two homeomorphic genera, *Cnestocythere* and *Schizocythere*, externally very much like *Hemicythere* but radically different in hinge structure and course of selvage are reported by Triebel (1950). Neither of these genera have as yet been discovered in the American Tertiaries.

Howe (1951, p. 17) described a new genus, *Urocythere*, from the middle Eocene Avon Park limestone of Florida with *U. attenuata* Howe as its genotype. This genus has the outline of *Caudites* Coryell and Fields but does not possess the surface ornamentation. It is more elongate than *Hemicythere* Sars, lacks the reticulate ornamentation and differs radically in the hinge structure and radial pore canals.

Hemicythere has hitherto been placed in the subfamily Cytherinae Dana. Sylvester-Bradley (1948, p. 793) included it in the family Trachyleberidae. In the opinion of the author the two genera, *Trachyleberis* and *Hemicythere*, are not nearly related and can not be included in Trachyleberidae. A new subfamily, Hemicytherinae, in the family Cytheridae Baird, is here proposed for the reception of the following related genera, with *Hemicythere* as its type genus: *Hemicythere* Sars, *Procythereis* Skosberg, *Caudites* Coryell and Fields, *Heterocythereis* Elofson, and *Urocythere* Howe.

LIST OF LOCALITIES

Listed below are the localities from which samples used were collected. References to locations contained in the text are indicated by the index number which precedes each entry.

1. Chipola, NE¼ NE¼ sec. 20, T. 1 N., R. 16 W., Washington County, Fla.
2. Chipola. SE¼ SE¼ sec. 8, T. 3 N., R. 16 W., Chimney Quarry, Washington County, Fla.
3. Chipola. SE¼ SE¼ sec. 5, T. 1 N., R. 16 W., Washington County, Fla.
4. Chipola. 1 mile below Scott's Bridge, NE¼ sec. 27, T. 2 N., R. 12 W., Bay County, Fla.
5. Chipola. In a ravine 200 yards east of Holmes Creek, NW¼ NE¼ sec. 28. T. 2 N., R. 16 W., Washington County, Fla.
6. Chipola. 220 yards below Walsingham Bridge, NE¼ sec. 15, T. 1 N., R. 13 W., Washington County, Fla.
7. Chipola. 1 mile below Gainer's Bridge, NW¼ sec. 34, T. 1 N., R. 13 W., Washington County, Fla.
8. Chipola. 1¾ miles below Scott's Bridge over Econfina Creek, NE ¼ NW¼ sec. 28, T. 2 N., R. 12 W., Bay County, Fla.
9. Chipola. At Red Hill Still, NE¼ NW¼ sec. 20, T. 1 N., R. 16 W., Washington County Fla.
10. Chipola. Lassiter Landing on Choctawhatchee River, SE¼ SE¼ sec. 13, T. 2 N., R. 17 W., Washington County, Fla.
11. Chipola. Ten Mile Creek, 4 miles south of Willis, Calhoun County, Fla.
12. Type Chipola. Ten Mile Creek, from bridge to ½ mile below bridge on the Marianna-Clarksville Road, 2376 feet south of NW corner of sec. 12, T. 1 N., R. 10 W., 22 miles south of Marianna, Calhoun County, Fla.
13. Chipola. NE¼ SW¼ sec. 28, T. 2N., R. 16 W., Washington County, Fla.
14. Chipola. SW¼ NE¼ sec. 31, T. 2 N., R. 16 W., Washington County, Fla.
15. Type Oak Grove. At old sawmill near Oak Grove on right bank of Yellow River, 300 feet south of NW corner of NE¼ NE¼ sec. 20, T. 5 N., R. 23 W., about 100 yards below bridge on Laurel Hill-Oak Grove road, Okaloosa County, Fla.
16. Oak Grove. Senterfiet's or Tanner's Mill (abandoned), sec. 14, T. 5 N., R. 23 W., 4 miles southwest of Laurel Hill, Okaloosa County, Fla.
17. Shoal River. Small gully, 50 feet south of road and 150 feet east of bridge over White's Creek on Eucheeanna-Knox Hill Road, NE¼ SE¼ SW¼ sec. 23, T. 2 N., R. 18 W., one mile west of Valley Church, Walton County, Fla.
18. Type Shoal River. Small branch ¼ mile southwest of residence of J.T.G. McClellan, SE¼ NW¼ sec. 4, T. 3 N., R. 21 W., about ⅜ mile west of shell bluff, Walton County, Fla.
19. Shoal River. Bottom of old fluorspar prospect shaft at a depth of 50 to 55 feet, about 4½ miles south of Argyle, Walton County, Fla.
20. Shoal River. Under bridge over Shoal River, 2¾ miles north of Mossyhead, SE corner of sec. 35, T. 4 N., R. 21 W., Walton County, Fla.
21. Type *Yoldia* zone. Frazier's farm (formerly Spencer farm), SE¼ sec. 18, T. 2 N., R. 19 W., Walton County, Fla.
22. *Yoldia* zone. Chester Spence farm, NE¼ NE¼ sec. 17, T. 2 N., R. 19 W., Walton County, Fla.
23. *Arca* zone. Road cut leading to an abandoned bridge on east bank of Alaqua Creek on Permenter's farm, sec. 17, T. 1 N., R. 19 W., Walton County, Fla.
24. *Arca* zone. W. E. Collin's farm, SE¼ NE¼ sec. 15, T. 2 N., R. 15 W., Washington County, Fla.
25. *Arca* zone. SW¼ NE¼ SW¼ sec. 16, T. 2 N., R. 15 W., Washington County, Fla.
26. *Arca* zone. NW¼ SE¼ sec. 16, T. 2 N., R. 15 W., spring head 100 yards east of road, Washington County, Fla.
27. *Arca* zone. SW¼ NW¼ sec. 15, T. 2 N., R. 15 W., Washington County, Fla.
28. *Arca* zone. SE¼ SW¼ NE¼ sec. 15, T. 2 N., R. 15 W., Washington County, Fla.
29. *Arca* zone. NW¼ SW¼ sec. 15, T. 2 N., R. 15 W., Washington County, Fla.
30. *Arca* zone. NE¼ SW¼ sec. 16, T. 2 N., R. 15 W., Washington County, Fla.
31. *Arca* zone. Flournoy's old mill, NE¼ NE¼ sec. 34, T. 3 N., R. 18 W., Holmes County, Fla.
32. *Arca* zone. In a steephead in the SW¼ NE¼ SW¼ sec. 16, T. 2 N., R. 15 W., along a small

ravine running west into south-side branch, Washington County, Fla.

33. *Arca* zone. Jim Kennedy Branch, 1 mile east of Red Bay, Walton County, Fla.
34. *Arca* zone. John Anderson's farm, sec. 10. T. 2 N., R. 17 W., ¾ mile east of Red Bay, Walton County, Fla.
35. *Arca* zone. At small spring head in E. Gomillion's field near Red Bay, Walton County, Fla.
36. Choctawhatchee. Pit of West Florida Power Co., just east of road at Power Dam, about 300 feet east of the Hydroelectric power plant near Ward, Liberty County, Fla.
37. *Ecphora* zone? 300 feet above Walsingham Bridge over Econfina Creek, NE¼ sec. 15, T. 1 N., R. 13 W., Washington County, Fla.
38. *Ecphora* zone. ¼ mile above Walsingham Bridge, SW¼ sec. 11, T. 1 N., R. 13 W., Washington County, Fla.
39. *Ecphora* zone. ¼ mile above Walsingham Bridge, SE¼ sec. 10, T. 1 N., R. 13 W., Washington County, Fla.
40. *Ecphora* zone? 220 yards above Walsingham Bridge, Econfina Creek, NE¼ sec. 15, T. 1 N., R. 13 W., Washington County, Fla.
41. *Ecphora* zone. Jackson Bluff, near top of section, Ocklocknee River, Leon County, Fla.
42. *Ecphora* zone. Jackson Bluff, Top shell bed, Ocklocknee River, Leon County, Fla.
43. *Ecphora* zone. *Pecten* Bed. Jackson Bluff, Ocklocknee River, Leon County, Fla.
44. *Ecphora* zone. Jackson Bluff, Ocklocknee River, Leon County, Fla.
45. *Ecphora* zone. Upper shell bed at Alum Bluff on the east side of the Apalachicola River, S½ NE¼ sec. 24, T. 1 N., R. 8 W., about 4 miles north of Bristol, Liberty County, Fla.
46. *Ecphora* zone. Cut in road leading to Watson's Landing, about 2 miles north of Alum Bluff and the same distance from the Apalachicola River, 2000 feet north and 100 feet west of SE corner of sec. 7, T. 1 N., R. 7 W., Liberty County, Fla.
47. *Ecphora* zone. Harvey Creek, ½ mile above old well at "Swimming Hole," 5 feet below water, Leon County, Fla.
48. *Cancellaria* zone. Gully pond, southeast of Greenhead, Washington County, Fla., on the Sales-Davis Lumber Co. property in the center of N½ NW¼ NE¼ sec. 14, T. 1 N., R. 14 W., at approximate elevation of 59 feet.
49. *Cancellaria* zone. 1 mile above Walsingham Bridge over Econfina Creek, NW¼ SW¼ sec. 11, T. 1 N., R. 13 W., Washington County, Fla.
50. *Cancellaria* zone. ¼ mile below Gainer's Bridge, Econfina Creek, SW¼ SE¼ sec. 33, T. 1 N., R. 13 W., Washington County, Fla.
51. *Cancellaria* zone. Borrow pit just east of the power dam at Jackson Bluff, Ocklocknee River, 500 feet east of NW corner, sec. 21, T. 1 S., R. 4 W., Leon County, Fla.
52. *Cancellaria* zone. NE¼ sec. 16, T. 1 S., R. 13 W., on Moccasin Creek beneath bridge, Bay County, Fla.
53. *Cancellaria* zone. Blue Sink, corner of NE¼ sec. 14, T. 1 N., R. 14 W., Washington County, Fla.
54. *Cancellaria* zone. ⅜ mile above Gainer's Bridge on Econfina Creek, NE¼ SE¼ sec. 33, T. 1 N., R. 13 W., Washington County, Fla.
55. *Cancellaria* zone. ½ mile above Gainer's Bridge on Econfina Creek, SE¼ NE¼ sec. 33, T. 1 N., R. 13 W., Washington County, Fla.
56. *Cancellaria* zone. In a small stream south of and under Gainer's Bridge in SW¼ SE¼ sec. 33, T. 1 N., R. 13 W., Washington County, Fla.
57. *Cancellaria* zone. In a small sink south of a community road in NW¼ SW¼ sec. 7, T. 1 N., R. 13 W., Washington County, Fla.
58. *Cancellaria* zone. Clarke's Pond, NE¼ SE¼ SW¼ sec. 12, T. 1 N., R. 12 W., Washington County, Fla.
59. Recent. Shore sand, Dogs Bay, near Roundstone County, Galway, Ireland. Arther Earland collection.

SYSTEMATIC DESCRIPTIONS

Order Ostracoda Latreille

Suborder Podocopa Sars

Family Cytheridae Baird

Hemicytherinae Puri, n. subfam.

Type genus: *Hemicythere* Sars.

Carapace of firm consistancy, calcareous, usually somewhat almond-shaped, smooth, pitted, reticulate or with longitudinal and dorsal ridges; valves inequal. Hinge of right valve with knob-like anterior tooth, postjacent socket which is continued as a groove to an outwardly directed tooth at the posterior cardinal angle. Pore canals numerous, long, closely spaced. Muscle scar pattern consists of a vertical row of four with additional three or four scars in an oblique row situated anteriorly.

The subfamily comprises the following genera: *Hemicythere* Sars, *Procythereis* Skogsberg, *Caudites* Coryell and Fields, *Heterocythereis* Elofson, and *Urocythere* Howe.

Genus **Hemicythere** Sars

Hemicythere Sars, 1925, p. 182; Klie, 1929, p. 282; Tressler, 1941, p. 100; Edwards, 1944, p. 517; Van den Bold, 1946, p. 28.
Auris Neviani, 1928, pp. 72, 94.

Genotype (by subsequent designation by Edwards, 1944): *Cythere villosa* Sars, 1865, p. 42. Recent, Norway.

Carpace usually almond-shaped, solid, with a semiconcave posterior dorsal margin; smooth pitted or reticulate; valves usually unequal in size.

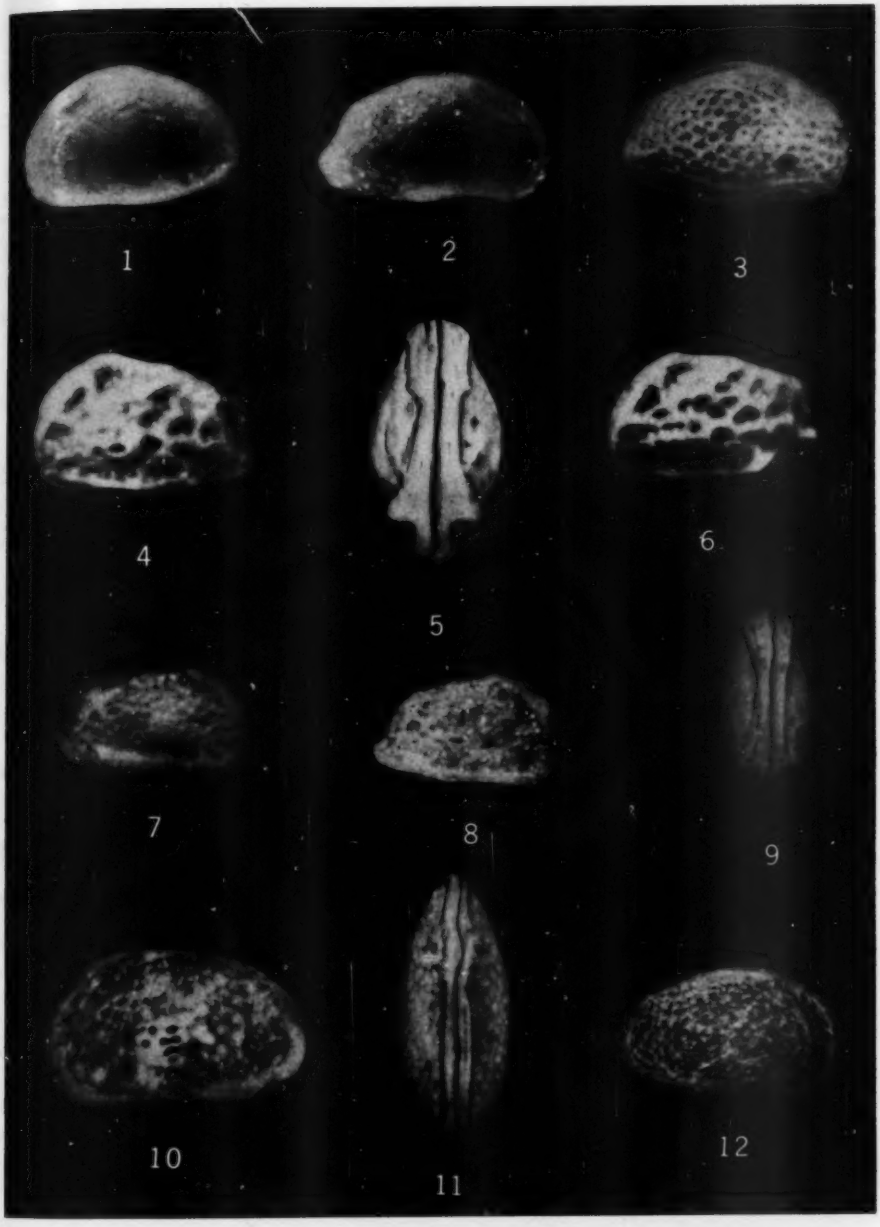


PLATE 1.—Genus *Hemicythere*. All figures × 67.5. Specimen numbers refer to the Henry V. Howe type collection at the Louisiana State University. Figs. 1, 2, *Hemicythere laevicula* Edwards, locality 42 (1, left valve, plesiotype no. 2467; 2, right valve, plesiotype no. 2468); Fig. 3, *H. amygdala* Stephenson, locality 1 (right valve view of a complete carapace, plesiotype no. 2469); Figs. 4–6, *H. confragosa* Edwards (4, left valve view of a complete carapace, plesiotype no. 2470, locality 42; 5, dorsal view of a complete carapace, plesiotype no. 2471, locality 43; 6, left valve, plesiotype no. 2472, locality 43); Figs. 7–9, *H. howei* Puri, n. sp. (7, right valve view, holotype no. 2473, locality 27; 8, right valve view of a complete specimen, paratype no. 2474, locality 43; 9, dorsal view of paratype no. 2474); Figs. 10–12, *H. villosa* (Sars), locality 59 (10, left valve, plesiotype no. 2475; 11, dorsal view of a complete carapace, plesiotype no. 2476; 12, right valve, plesiotype no. 2477).

Hinge of the right with a knoblike anterior tooth, broad postjacent socket which is continued as a strong, outwardly directed tooth at posterior cardinal angle. Marginal area broad; inner margin and line of concrescence coincide; pore canals numerous, closely spaced, nearly straight. Muscle scar pattern consists of a vertical row of five scars with additional two to three scars situated anteriorly.

Range: Eocene to Recent.

The following species are considered to be good *Hemicythere:*

H. amygdala Stephenson, 1944, p. 158.
H. angulata (Sars) (*Cythere angulata* Sars, 1865, p. 46).
H. antillea Van den Bold, 1946, p. 101.
H. arenicola (Cushman) (*Cythereis arenicola* Cushman, 1906, p. 379).
H. balatonica (Zalanyi) (*Cythereis balatonica* Zalanyi, 1913, p. 126).
H. borealis (Brady) (*Cythere borealis* Brady, 1868, p. 31).
H. brunnea (Brady) (*Cythere brunnea* Brady, 1898, p. 442.)
H. californiensis Le Roy, 1943, p. 366.
H. californiensis hispida Le Roy, 1943, p. 367.
H. cimbaeformis (Seguenza) (*Cythere cimbaeformis* Seguenza, 1882, p. 22).
H. concinna (Jones) (*Cythere concinna* Jones, 1857, p. 29).
H. confrayosa Edwards, 1944, p. 518.
H. conradi Howe and McGuirt, in Howe *et al.*, 1935, p. 27.
H. conveza (Baird) (*Cythere conveza* Baird, 1850, p. 174).
H. conveza turgida (Zalanyi) (*Cythere convexa turgida* Zalanyi, 1913, p. 126)
H. crenulata (Sars) (*Cythere crenulata* Sars, 1865, p. 39).
H. emarginata (Sars) (*Cythereis emarginata* Sars, 1865, p. 38).
H. expunctata (Zalanyi) (*Cythereis expunctata* Zalanyi, 1913, p. 126).
H. finmarchica (Sars) (*Cythereis finmarchica* Sars, 1865, p. 41).
H. jollaensis LeRoy, 1943, p. 365.
H. kerguelensis (Brady) (*Cythere kerguelensis* Brady, 1880, p. 78).
H. kniffeni Howe and Law, 1936, p. 67.
H. kolesnikovi (Schneider) (*Cythereis kolesnikovi* Schneider, 1939, p. 198).
H. laevicula Edwards, 1944, p. 518.
H. latimarginata (Speyer) (*Cythere latimarginata* Speyer, 1863, p. 22).
H. lattorifiana (Lienenklaus) (*Cythereis lattorifiana* Lienenklaus, 1900, p. 513).
H. limbata (Bosquet) (*Cythere limbata* Bosquet, 1852, p. 78).
H. margaritifera (G. W. Müller) (*Cythereis margaritifera* G. W. Müller, 1894, p. 368).
H. marginata (Norman) (*Cythere marginata* Norman, 1862, p. 47).
H. mehesi (Zalanyi) (*Cythereis mehesi* Zalanyi, 1913).
H. merita (Zalanyi) (*Cythereis merita* Zalanyi, 1913).
H. minuta Edwards, 1944, p. 519.
H. oblonga (Brady) (*Cythere oblonga* Brady, 1866, p. 373, not *Cythere oblonga* McCoy, 1844) = *Cythereis* (*Auris*) *distingueda* Neviani, 1928 (new name for *Cythere oblonga* Brady, 1866).
H. palosensis LeRoy, 1943, p. 365.
H. perforata (Zalanyi) (*Cythereis perforata* Zalanyi, 1913, p. 141).
H. pulchella (Brady) (*Cythere pulchella* Brady, 1868, p. 404).
H. punctistriata (Ulrich and Bassler) (*Cythere punctistriata* Ulrich and Bassler, 1904, p. 108).
H. quadridentata (Baird) (*Cythere quadridentata* Baird, 1850, p. 413).
H. saginata Stephenson, 1944, p. 158.
H. sarmatica (Zalanyi) (*Cythereis sarmatica* Zalanyi, 1913, p. 127).
H. schreteri (Zalanyi) (*Cythereis schreteri* Zalanyi, 1913, p. 130).
H. speyeri (Brady) (*Cythere speyeri* Brady, 1868, p. 222).
H. stolonifera (Brady) (*Cythere stolonifera* Brady, 1880, p. 89).
H. strandentia Tressler and Smith, 1948, p. 19.
H. subangusta (Zalanyi) (*Cythereis subangusta* Zalanyi, 1913).
H. symmetrica Van den Bold, 1946, p. 102.
H. truitti Tressler and Smith, 1948, p. 18.
H. villosa (Sars) (*Cythereis villosa* Sars, 1865, p. 42).

The following species have been erroneously assigned to *Hemicythere*:

H. calhounensis Smith, 1941, p. 280.
H. dalli Howe and Brown, in Howe *et al.*, 1935, p. 28.
H. dalli redbayensis Howe and Brown, in Howe *et al.*, 1935, p. 29.
H. sellardsi Howe and Neill, in Howe *et al.*, 1935, p. 29.

Hemicythere laevicula Edwards

Pl. 1, Figs. 1, 2

Hemicythere laevicula Edwards, 1944, p. 518, pl. 86, figs. 27–30.

This species was originally described from the Duplin marl of North Carolina. It is very close to *H. conradi* but differs in its less strong ornamentation and somewhat elongate nature of the carapace.

Dimensions of the plesiotype no. 2468, a right valve: Length 0.625 mm; height 0.371 mm; plesiotype no. 2467, a left valve: Length 0.608 mm; height 0.371 mm. Both the figured specimens came from locality 42. This species also occurs at *Ecphora* zone localities 39, 41, and 47 and *Arca* zone locality 27 and questionably at locality 30.

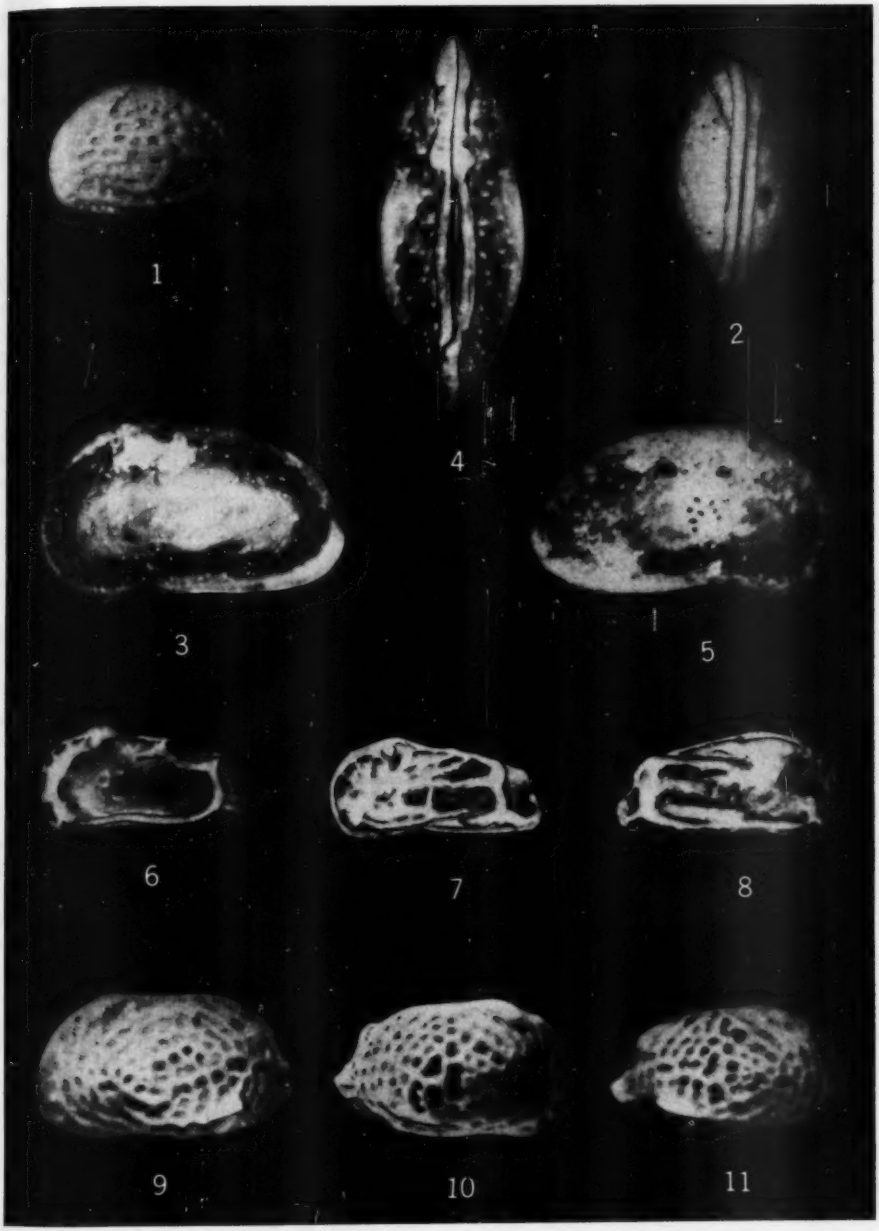


PLATE 2.—*Hemicythere* and related genera. All figures × 67.5. Specimen numbers refer to the Henry V. Howe type collection at the Louisiana State University. Figs. 1, 2, *Hemicythere conradi* Howe and McGuirt, locality 43 (1, left valve view of a complete specimen, plesiotype no. 2478; 2, dorsal view of plesiotype no. 2478); Figs. 3–5, *Heterocythereis* sp., locality 59 (3, left valve, plesiotype no. 2479; 4, dorsal view of a complete carapace, plesiotype no. 2480; 5, right valve, plesiotype no. 2481); Fig. 6, *Caudites sellardsi* (Howe and Neill) (left valve view of a complete specimen, plesiotype no. 2482, locality 24); Figs. 7, 8, *C. chipolensis* Puri, n. sp., locality 6 (7, left valve, holotype no. 2483; 8, right valve, paratype no. 2484); Figs. 9–11, *Procythereis calhounensis* (Smith), locality 1 (9, left valve, plesiotype no. 2485; 10, right valve, plesiotype no. 2486; 11, right valve, plesiotype no. 2487).

Hemicythere conradi Howe and McGuirt
Pl. 2, Figs. 1, 2

Hemicythere conradi Howe and McGuirt, in Howe *et al.*, 1935, p. 27, pl. 3, figs. 31–34, pl. 4, fig. 17; Edwards, 1944, p. 518, pl. 86, figs. 17, 18.

Carapace small, subovate in side view. Dorsal margin moderately arched, ventral margin slightly concave near the middle. Anterior end broadly rounded below, obliquely rounded dorsally; posterior end narrow and compressed. Both anterior and posterior margins bear low rounded rim. Surface of the carapace ornamented with reticulate pattern of rounded ridges separating elongate, rounded pits.

Dimensions of the plesiotype no. 2478, a complete carapace from locality 43: Length 0.557 mm; height 0.405 mm.

This species was originally reported from beds of Chipola to Choctawhatchee in age. It also occurs at the *Arca* zone localities 24, 26, 27, 28, 29, and 30; *Ecphora* zone localities 37, 38, 39, 40, 42, 43, 44, 47, and *Cancellaria* zone localities 48, 49, 50, 53, 54, 55, 57, and 58.

Hemicythere confragosa Edwards
Pl. 1, Figs. 4–6

Hemicythere confragosa Edwards, 1944, p. 518, pl. 86, figs. 23–26.

This species resembles *H. conradi* but could easily be distinguished from it by its much stronger ornamentation. It was originally described from the Duplin marl of North Carolina but also occurs at Florida localities 39, 41, 42, and 47.

Dimensions of plesiotype no. 2470, a complete specimen: Length 0.540 mm; height 0.338 mm; plesiotype no. 2471, a complete carapace: Length 0.608 mm; height 0.371 mm; plesiotype no. 2472, a left valve: Length 0.591 mm; height 0.354 mm. The figured specimens came from *Ecphora* zone localities 42 and 43.

Hemicythere amygdala Stephenson
Pl. 1, Fig. 3

Hemicythere amygdala Stephenson, 1944, p. 158, pl. 28, figs. 8, 9.

This species is very similar to *H. conradi* from which it differs in its more ovate form in side view, more closely spaced pitting pattern and more obscure cardinal angles. This species was originally described from the *Marginulina-Heterostegina-Discorbis* zones of Texas.

Dimensions of the plesiotype no. 2469, a complete specimen from locality 1: Length 0.591 mm; height 0.371 mm. This species also occurs at the Chipola localities 2, 3, 4, 5, 6, 7, 11, and 13; Oak Grove localities 15 and 16; and Shoal River locality 17.

Hemicythere howei Puri, n. sp.
Pl. 1, Figs. 7–9

Carapace small, thickest near the middle, in side view subovate. Dorsal margin straight, ventral margin slightly convex near the middle. Anterior end broadly rounded, posterior end sharply triangular. Surface of the carapace finely reticulate. There is a thickened marginal rim present which is generally more pronounced at the ventral margin. Hinge normal for the genus.

Dimensions of holotype no. 2473, a complete carapace: Length 0.507 mm; height 0.304 mm; paratype no. 2474, a complete carapace: Length 0.490 mm; height 0.304 mm. The figured specimens came from the *Arca* zone locality 27 and *Ecphora* zone locality 43.

This species is close to *H. conradi*, but it can easily be distinguished from it by its marginal thickened rim, finely reticulate ornamentation, and angular shape.

Genus **Caudites** Coryell and Fields

Caudites Coryell and Fields, 1937, p. 10; Van den Bold, 1946, p. 31.

Genotype: Caudites medialis Coryell and Fields, 1937, p. 11. Miocene, Gatun formation, Panama.

Carapace small, thick-shelled, elongate, subtriangular. The anterior with a thickened rim and with additional longitudinal and dorsal ridges. Surface largely smooth. Anterior end broadly rounded; posterior rather drawn out. The valves decidedly compressed. Hinge similar to *Hemicythere*.

Range: Eocene to Recent.

Caudites sellardsi (Howe and Neill)
Pl. 2, Fig. 6

Hemicythere sellardsi Howe and Neill, in Howe *et al.*, 1935, pp. 29, 30, pl. 2, figs. 6, 10.

This species was based on a single complete carapace from the Choctawhatchee locality 34. It is an excellent marker of the *Arca* zone and has also been found at localities 23, 24, 25, 28, and 30.

Dimensions of the plesiotype no. 2482, a complete carapace from locality 24: Length 0.557 mm; height 0.287 mm.

Caudites chipolensis Puri, n. sp.
Pl. 2, Figs. 7, 8

Carapace small, compressed subtriangular in outline. Anterior end broadly rounded, posterior end much narrower; dorsal and ventral margins sinuous and converging towards the posterior. Three prominent transverse raised ribs emerge at the posterior rostrum and continue for three-fourths of the distance toward the anterior end before they merge with the anterior slope. There is usually a thickened rim around the margins. A number of short, transverse ribs produce subreticulate effect.

Dimension of holotype no. 2483, a left valve: Length 0.591 mm; height 0.287 mm; paratype no. 2484, a right valve: Length 0.625 mm; height 0.304 mm. Both the figured specimens came from Chipola locality 6. It also occurs at Chipola localities 4 and 12 and is an excellent marker for the Chipola formation.

C. chipolensis resembles *C. sellardsi* but could easily be identified from it by three transverse ribs, more pronounced subreticulate pattern of ornamentation, and slightly larger carapace.

Genus **Procythereis** Skosberg

Cythereis (*Procythereis*) Skosberg, 1928, p. 17.

Genotype (by original designation): *Cythereis* (*Procythereis*) *torquata* Skosberg, 1928, p. 19. Recent, Tierra del Fuego.

Shell a *Hemicythere* with a nearly straight dorsal margin which nearly parallels the sinuous ventral margin. Anterior end obliquely rounded; posterior angular below and above, truncated just below middle. Surface pitted to almost reticulate, with a strong alate ridge near the ventral margin which bears a row of oblique excavations on its upper side. Hinge similar to *Hemicythere*.

On the basis of soft parts, Skosberg subdivided *Procythereis* into two groups: *Torquata* and *Radiata*.

Range: Miocene to Recent.

Procythereis calhounensis (Smith)
Pl. 2, Figs. 9–11

Hemicythere calhounensis Smith, 1941, pp. 280, 281, pl. 1, fig. 7; pl. 2, fig. 11.

Carapace subquadrate, stout, and fat. Inflated ventrally with an ala. Dorsal margin slightly convex, ventral margin slightly sinuous; both margins converging posteriorly. Anterior end broadly rounded, somewhat produced ventrally, posterior narrow. Surface of the carapace reticulate, the pits being arranged in a linear series in curved rows. Hinge similar to *Hemicythere*.

Dimensions of plesiotype no. 2485, a left valve: Length 0.695 mm; height 0.371 mm; plesiotype no. 2486, a right valve: Length 0.608 mm; height 0.371 mm; plesiotype no. 2487, a right valve: Length 0.608 mm; height 0.354 mm. All figured specimens came from Chipola locality 1.

This species was originally described from the Chipola locality 12. It is an excellent Chipola marker and occurs at localities 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, and 13.

BIBLIOGRAPHY

BAIRD, WILLIAM. *The natural history of the British Entomostraca*. Ray Soc., London **18:** i–viii, 1–364, pls. 1–36 (Ostracoda, pp. 138–182, pls. 18–23). 1850.

BLAKE, C. H. *Ostracoda*, in Biological Survey of Mount Desert Region. Pt. **5:** 229–241, fig. 40. 1933.

BRADY, G. S. *On new or imperfectly known species of marine Ostracoda* (1865). Trans. Zool. Soc. London **5:** 359–393, pls. 57–62. 1866.

———. *A monograph of the Recent British Ostracoda*. Trans. Linnean Soc. London **26:** 353–495, pls. 23–41. 1868.

———. *Marine Ostracoda from the Mauritius*. Ann. Mag. Nat. Hist. (4) **2:** 220–225, pls. 14, 15. 1868.

———. *Ostracoda from the Arctic and Scandinavian seas*. Ann. Mag. Nat. Hist. (4) **2:** 30–35, pls. 4, 5. 1868.

———. *Les fonds de la mer* **1:** 54–163, pls. 4–19. 1869.

———. *Report on the scientific results of the voyage of H. M. S. Challenger during the years 1873–1876*, Zoology **1** (3): *Ostracoda*, 184 pp., 44 pls. 1880.

———. *On new or imperfectly-known Ostracoda, chiefly from New Zealand*. Trans. Zool. Soc. London **14:** 429–452, pls. 43–47 . 1898.

———. *On new or imperfectly known Ostracoda, chiefly from a collection in the Zoological Museum, Copenhagen*. Trans. Zool. Soc. London **16** (4): 179–210, pls. 21–25. 1902.

CORYELL, H. N., and FIELDS, SUZANNE. *A Gatun ostracode fauna from Cativa, Panama*. Amer. Mus. Nov. 956: 18 pp., 2 pls. 1937.

CUSHMAN, J. A. *Marine Ostracoda of Vineyard Sound and adjacent waters*. Proc. Boston Soc. Nat. Hist. **32** (10): 359–385, pls. 27–38. 1906.

EDWARDS, RICHARD A. *Ostracoda from the Duplin marl (upper Miocene) of North Carolina*. Journ. Pal. **18** (6): 505–528, pls. 85–88. 1944.

ELOFSON, OLOF. *Zur Kenntnis der marinen Ostracoden Schwedens mit besonderer Berücksichtigung des Skageraks*. Zool. Bidrag. **19:** 217–518, 42 figs. 1941.

HOWE, H. V. *New Tertiary ostracode fauna from Levy County, Florida*. Florida Geol. Surv. Bull. 34, pt. 1: 1–32, 5 pls. 1951.

HOWE, H. V., and CHAMBERS, JACK. *Louisiana Jackson Eocene Ostracoda*. Louisiana Geol. Surv. Bull. 5: 1–65, 6 pls. 1935.

HOWE, H. V., et al. *Ostracoda of the* Arca *zone of the Choctawhatchee Miocene of Florida*. Florida Geol. Surv. Bull. 13: 1–37, 4 pls. 1935.

JONES, T. RUPERT. *A monograph of the Tertiary Entomostraca of England*. Palaeontogr. Soc. London **9** (2): 68 pp., 6 pls. 1856 [1857].

KLIE, W. *Beitrag zur Kenntnis der Ostracoden der sudlichen und westlichen Ostsee, der festlandischen Nordseekueste und der Insel Helgoland*. Zeitschr. Wiss. Zool. Leipzig **134:** 270–306. 1929.

LEROY, L. W. *Pleistocene and Pliocene Ostracoda of the coastal region of southern California*. Journ. Pal. **17:** 354–373, pls. 58–62. 1943.

LIENENKLAUS, E. *Die Ostracoden des mitteleren Nord-deutschlands*. Deutsch. geol. Ges. **52:** 497–550, pl. 19–22, 10 figs. 1900.

MÜLLER, G. W. *Fauna und Flora des Golfes von Neapal*. Zool. Station Naples Mon. **21:** viii-404, 40 pls. 1894.

NAMIAS, I. *Ostracodi fossili della Farnesina e M. Mario*. Paleontologr. Italica **6:** 83–112, pls. 14–15. 1900.

NEVIANI, A. *Ostracodi fossili d' Italia. I. Vallebiaja (Calabriano)*. Mem. Pont. Acc. Nuovi Lincei ser. 2, **11:** 1–118, pls. 1–2. 1928.

RANGE OF HEMICYTHERE IN AMERICA

SPECIES OF HEMICYTHERE	FORMATIONS											
	Eocene		Oligocene		Miocene							Recent
	Avon Park limestone	West Indies	Mariana	*Marginulina-Heterostegina-Discorbis* z.	West Indies	Chipola	Oak Grove	Shoal River	*Foldia* zone	*Arca* zone	Calvert	Duplin	North Atlantic
arenicola													XXX
concinna													XXX
crenulata													XXX
strandentia													XXX
truitti													XXX
confragosa												XXX	
laevicula												XXX	
minuta												XXX	
howei										XXX		XXX	
punctistriata											XXX		
conradi						XXX	XXX	XXX	XXX	XXX		XXX	
antillea					XXX								
amygdala				XXX									
saginata				XXX									
kniffeni			XXX										
limbata		XXX											
symmetrica		XXX											
aleatoria	XXX												
bellula	XXX												
cribraria	XXX												
lemniscata	XXX												
lienosa	XXX												
phrygionia	XXX												
mota	XXX												

RANGE OF CAUDITES IN AMERICA

(Species listed under the generic name under which they were originally described)

SPECIES	FORMATIONS					
	Lower Eocene, Guatemala	Chipola Miocene, Florida	*Arca* zone Miocene, Florida	Gatun Miocene, Panama	Pleistocene, Southern California	Recent, Panama
Cythere rectangularis Brady, 1869, p. 153						XXX
Caudites fragilis LeRoy, 1943, p. 372					XXX	
Caudites medialis Coryell and Fields, 1937, p. 11				XXX		
Hemicythere sellardsi Howe and Neill, in Howe *et al.*, 1935, p. 29			XXX			
Caudites chipolensis Puri, n. sp.		XXX				
Caudites nipcensis Van den Bold, 1946, p. 103	XXX					

NORMAN, A. M. *On species of Ostracoda new to Great Britain*. Ann. Mag. Nat. Hist. (3) **9**: 43–47. 1862.

SARS, G. O. *Oversigt af Norges marine Ostracoder*. Forh. Vid. Christiania. 1865: 1–130. 1866.

———. *An account of the Crustacea of Norway: Ostracoda*. **9** (pts. 5–12): 73–208, 64 pls. 1925.

SCHNEIDER, G. *Miocene Ostracoda of the Crimea-Caucasian region*. Problems of Paleontology **5**: Moscow Univ. Publ.: 177–202 (Russian), 203–208 (English summary), 4 pls. 1939.

SEGUENZA, G. *Il quaternario di Rizzolo II: Gli Ostracodi. con I tavola*. Passim ne: Il Naturalista Siciliano, anni II–V. 1882–1886.

SKOGSBERG, TAGE. *Studies on marine Ostracoda, Part II*. Occ. Pap. California Acad. Sci. **15**: 1-154, 6 pls., 23 figs. 1928.

SMITH, R. HENDEE. *Micropaleontology and stratigraphy of a deep well at Niceville, Okaloosa County, Florida*. Bull. Amer. Assoc. Petr. Geol. **25**: 263–286, 2 pls., 3 figs. 1941.

SPEYER, O. *Die Ostracoden der Casseler Tertiarbildungen*. Cassele, 1863.

STEPHENSON, MORTON B. *New Ostracoda from subsurface Middle Tertiary strata of Texas*. Journ. Pal. **18**: 156–161, pl. 28. 1944.

SYLVESTER-BRADLEY, P. C. *The ostracode genus* Cytherеis. Journ. Pal. **22**: 792–797, pl. 122, 1 fig. 1948.

TRESSLER, WILLIS L. *Geology and biology of North Atlantic deep-sea cores between Newfoundland and Ireland, Part 4, Ostracoda*. U. S. Geol. Surv. Prof. Pap. 196-C: i–xviii, 96–104, pl. 19. 1941.

TRESSLER, WILLIS L., and SMITH, ESSIE M. *An ecological study of seasonal distribution of Ostracoda, Solomons Island, Maryland region*. Chesapeake Biol. Lab. Publ. 71: 61 pp., 4 pls. 1948.

TRIEBEL, ERICH. *Die Ostracoden der deutschen Kreide. 3: Cytherideinae und Cytherinae aus der Unteren Kreide*. Senckenbergiana **22**: 160–227, 10 pls. 1940.

———. *Homöomorphe Ostracoden-Gattungen*. Senckenbergiana **31**: 313–330, 4 pls. 1950.

ULRICH, E. O., and BASSLER, R. S. *Systematic paleontology of the Miocene deposits of Maryland, Ostracoda:* 98–130, pls. 35–38. 1904.

VAN DEN BOLD, WILLEM A. *Contribution to the study of Ostracoda with special reference to the Tertiary and Cretaceous microfauna of the Caribbean region:* 167 pp., 18 pls. Amsterdam. 1946.

ZALANYI, BELA. 1913, *Miocäne Ostrakoden aus Ungarn*. Mitt. Jahrb. Ung. Geol. Reichstanst. **21** (4): 85–152, pls. 5–9. 1913.

BOTANY.—*Floral morphology of* Ixophorus unisetus (*Presl*) *Schlecht*. ERNEST R. SOHNS,[1] U. S. National Museum. (Communicated by Agnes Chase.)

Ixophorus, a monotypic genus in the tribe Paniceae (Gramineae), is placed among those grasses regarded as highly specialized. The spikelets are 2-flowered; the lower floret is staminate and the upper floret is perfect (but the rudimentary stamens of this floret are nonfunctional). This grass is related to *Setaria*, *Setariopsis*, *Chamaeraphis*, *Paratheria*, *Pennisetum*, the section *Paurochaetium* of *Panicum* and other genera having their spikelets surrounded and/or subtended by sterile branches. The spikelet (or spikelets), with surrounding or subtending bristle (or bristles), constitutes the fascicle.

The taxonomic position of this grass has been in doubt. The genus has been confused with other panicoid genera. The purpose of this paper is to clarify the morphology of the fascicle of this interesting species.

[1] Part of a thesis, "The Floral Morphology of *Cenchrus*, *Pennisetum*, *Setaria* and *Ixophorus*," submitted to the faculty of the Graduate School of Indiana University in partial fulfillment of the requirements for the degree doctor of philosophy. The writer is grateful to Dr. Paul Weatherwax for suggesting the problem and for helpful suggestions throughout the investigation.

Historical.—The species was first described by J. S. Presl (1830) as *Urochloa uniseta*, based on a specimen collected by Thaddaeus Haenke in Mexico. Schlechtendal (1861–1862), apparently having access only to Presl's description and to a drawing of a species of *Urochloa* from the Isle de France (*pl. 11, f. 1*, in the Atlas of Beauvois, Ess. Agrost. 1812) established the genus *Ixophorus*. He was not certain whether to assign the plant to a genus or to a section of *Panicum*, viz., ". . .so bilde ich aus diesen Pflanzen eine eigene Abtheilung, welche man Gattung oder *Panicum*-Section nach Belieben nennen mag, und bezeichne sie mit einem eigenen Namen: *Ixophorus*." Nevertheless, Schlechtendal properly described the genus (p. 420–421) and the combination was made in the index (p. 747). The resemblance of this species to *Panicum* led Trinius (1834) to transfer Presl's species to *Panicum*. Fournier (1886) transferred the species to *Setaria*. Vasey (1893), in naming grasses collected by Palmer in Sonora and Colima, Mexico, described Presl's species under *Panicum* (*P. pringlei*). *Setaria* is a name which was first applied to a genus of lichens by Acharius and later to a genus of grasses by Beauvois (Hitchcock, 1925). Beauvois' name has been conserved, but the homonym caused

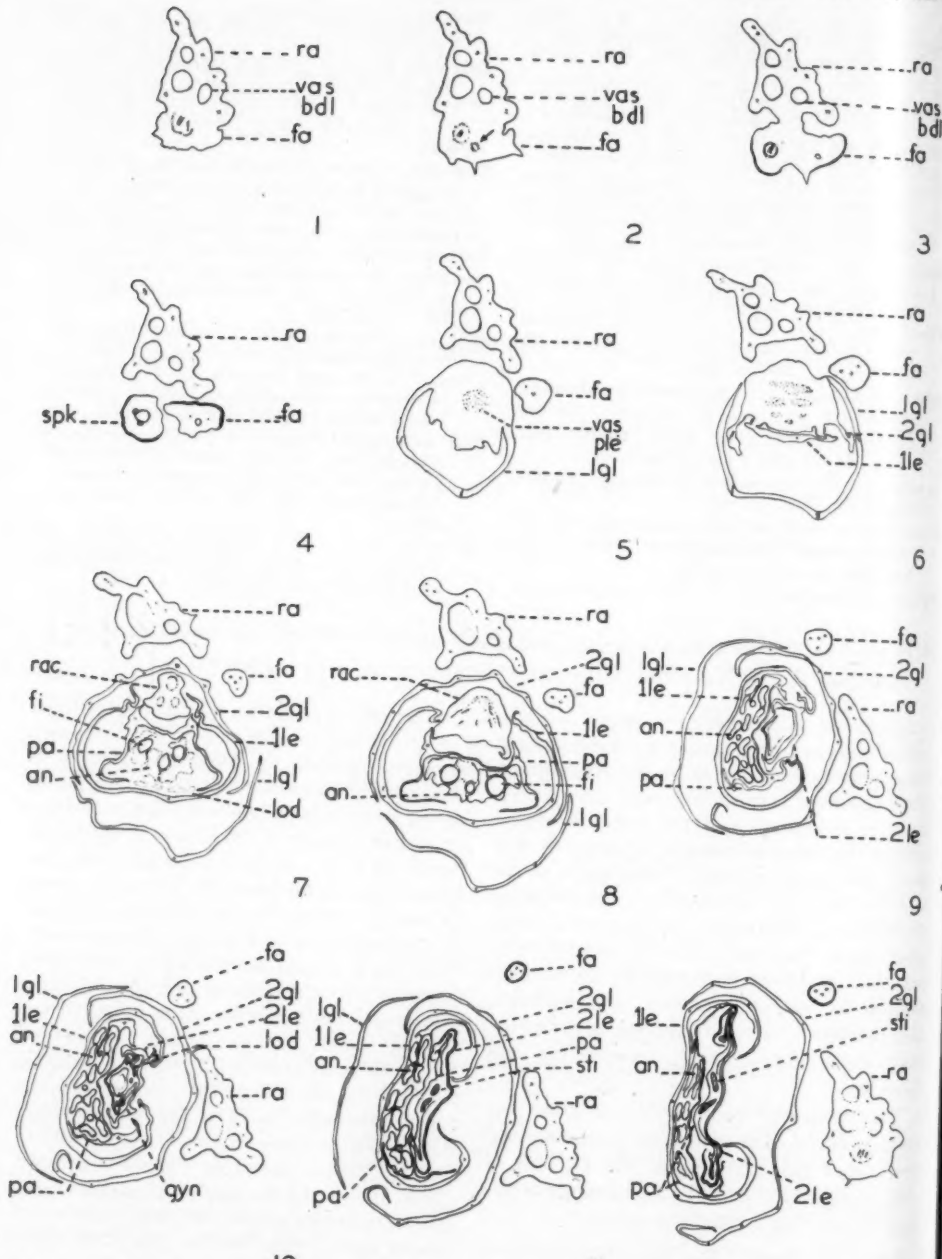


FIG. 1–12.—Diagrammatic transsections of the rachis and fascicle of *Ixophorus unisetus*. an—anther; fa—fascicle; fi—filament; 1 gl—first glume; 2 gl—second glume; gyn—gynoecium; 1 le—lemma of the lower floret; 2 le—lemma of the upper floret; lod—lodicule; pa—palea; ra—rachis; rac—rachilla; spk—spikelet; sti—stigma; vas bdl—vascular bundle; vas ple—vascular plexus. All figures approximately × 25.

much trouble before it was included in Nomina Generica Conservanda. Nash (1895), seeking a valid name for *Setaria*, concluded that *Ixophorus* was the earliest valid name and transferred the species of *Setaria* to *Ixophorus*. Beal (1896) misapplied the name of the Australian genus, *Chamaeraphis*, to *Setaria* and *Ixophorus*. See Pilger (1928) for a history and discussion of the genus *Chamaeraphis*. Hitchcock (1936) stated that *Chamaeraphis* is "an Old World genus in which the articulation is below the spikelet-bearing branches, as in Pennisetum." F. Lamson-Scribner (1897) used the generic name *Ixophorus* and proposed a new species and a variety (both since relegated to synonomy under *I. unisetus*). The history of the genus and its synonomy was published by Hitchcock (1919).

Distribution and economic importance.—*Ixophorus unisetus* was first found in Mexico (Hitchcock, 1919). Its present distribution, based on specimens in the U. S. National Herbarium, includes Mexico, El Salvador, Guatemala, Honduras, Nicaragua, and Costa Rica; Cuba; Colombia, Venezuela, and Brazil. The grass is cultivated in all these countries and has been grown in Experiment Stations in the United States and Hawaii. It is reported to be a good, palatable, annual forage grass. This species is known under a dozen or more vernacular names, e. g., Copo sojo, Honduras grass, Mesmete, Molino grass, Pasto Atico, Pasto blanco, Pindiniqua, Pitillo, Zacate blanco, Zacate dulce, Zacate conejo, Zacate de Honduras and Tonciro.

Material and method.—Material was collected at Quirigua, Guatemala, and provided by Dr. Paul Weatherwax. Fascicles were processed according to standard methods in microtechnique. All drawings were made with the aid of a camera lucida. Figs. 1–12 are diagrammatic drawings made from serial sections of a portion of an inflorescence.

Observations.—A diagrammatic transsection of the rachis (*ra*) is shown in Fig. 1. The vascular supply of the fascicle (*fa*) is indicated by the dotted area in the lower left of the figure, while the irregular circular areas represent vascular bundles (*vas bdl*) of the rachis. A transsection of the rachis shows a well-defined, cutinized epidermis and a central parenchyma area having small vascular bundles near the periphery and two to four larger, centrally located, vascular bundles. In fig. 2 the vascular mass of the fascicle is divided into two unequal areas, the smaller of which (indicated by an arrow) is the vascular supply of the bristle and the larger is the vascular supply of the spikelet. Fig. 3 shows the relationship of the fascicle axis (*fa*) to the rachis (*ra*). The relationship of the fascicle axis (*fa*), spikelet (*spk*) and rachis (*ra*) is shown in Fig. 4. At the level of Fig. 5, the first glume (*1 gl*) is shown. The stippled area in the base of the spikelet represents the main vascular plexus (*vas ple*) of the spikelet. In Fig. 6, the first glume (*1 gl*), the second glume (*2 gl*), and the lemma of the lower floret (*1 le*) are shown. The organization of the lower floret is diagrammed in Fig. 7. The palea (*pa*) is strongly 2-keeled and each keel has a pronounced wing at maturity. The pistil does not develop and its vascular trace terminates blindly. The bases of the filaments (*fi*) are multicellular and thick. The three anthers (*an*) are indicated by outline. The lower floret has two lodicules (*lod*), which are large and well-developed, and the position of each is indicated by a dotted outline. The rachilla segment (*rac*) below the upper floret is shown at two successively higher levels in Figs. 7 and 8. The organization of the fascicle above the level shown in Fig. 8 could not be followed because shattering ruined subsequent serial sec-

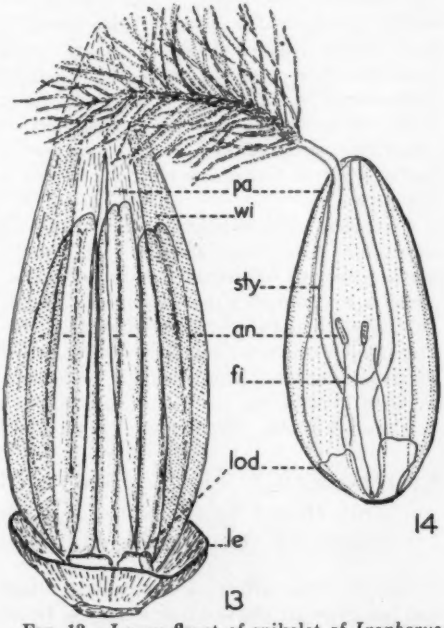


FIG. 13.—Lower floret of spikelet of *Ixophorus unisetus*. FIG. 14.—Upper floret of same spikelet. an—anther; fi—filament; le—lemma; lod—lodicule; pa—palea; sty—style; wi—wing. Both figures approximately × 7.

tions. Another portion of the same inflorescence was selected to show the organization of the upper floret. The first of these diagrams is that of Fig. 9 showing the lemma (*2 le*). In Fig. 10, the upper floret is shown with two lodicules (*lod*), three filaments (*fi*) [shown as black dots], and a gynoecium (*gyn*). The palea (*pa*) of the upper floret is keeled, but the keels are not as prominent as those of the palea of the lower floret. At the levels in Figs. 11 and 12, the anthers (*an*) of the lower floret, and the stigmas (*sti*) of the upper floret are shown.

Examination of the material in the U. S. National Herbarium revealed no lower florets (Fig. 13) with pistils, but an upper floret (Fig. 14) occasionally has nonfunctional stamens. The anthers of the upper floret are small, empty, sac-like structures. In Fig. 14, one anther is missing as well as one branch of the stigma.

F. Lamson-Scribner (1897) used the character of smooth bristles as one criterion for separating *Ixophorus* from *Panicum*. Forty-one percent of the material in the U. S. National Herbarium has antrorsely scabrous bristles. These bristles vary from scabrous at the base to half their length. The remainder (59 percent) of the material has viscid, smooth bristles. Smooth bristles have a heavy cuticle. The axis of the inflorescence varies from scabrous to pilose-pubescent. The individual plants range from 10 cm to 1 meter in height. These characters, whether taken separately or collectively, are of insufficient magnitude to warrant segregation of another species or a variety in this genus.

Discussion.—The fascicle of *Ixophorus unisetus* consists of a 2-flowered spikelet with a single bristle prolonged behind it. The bristle is interpreted as a continuation of the axis of the fascicle. The spikelet has two distinctly different florets. The lower is larger, membranous, staminate and the upper is smaller, indurated, and functionally pistillate. In addition, each floret has two well-developed lodicules. The paleas of both florets are winged at maturity. The very small nonfunctional stamens of the upper floret, the presence of lodicules in both florets, and the wings on the paleas are types of specialization not common to most panicoid grasses.

Summary.—The taxonomic history and the morphology of the fascicle of the monotypic genus *Ixophorus* are presented in this paper. A morphological study of the fascicle indicates that this genus is separate and distinct in the *Paniceae* and has specializations not common to most panicoid grasses.

LITERATURE CITED

BEAL, W. J. *Grasses of North America* **2:** 150–159. New York, 1896.

FOURNIER, E. *Mexicanas plantas*; pt. 2: 43. Ex Typographeo Republicae, Parisiis, 1886.

HITCHCOCK, A. S. *History of the Mexican grass, Isophorus unisetus.* Journ. Washington Acad. Sci. **9:** 546–551. 1919.

———. *Descriptive systematic botany*: 125. New York, 1925.

———. *The genera of grasses of the United States, with special reference to the economic species.* (Revised by Agnes Chase). U. S. Dept. Agr. Techn. Bull. 772: 251. 1936.

PRESL, J. S. *Reliquiae Haenkeanae*: 319. Prag, 1830.

LAMSON-SCRIBNER, F. *Studies on American grasses. I. The genus* Ixophorus. U. S. Dept. Agr. Div. Agrost. Bull. 4: 5–7, pls. 1–2. 1897.

NASH, G. V. *New or noteworthy American grasses.* —I. Bull. Torrey Bot. Club **22:** 419–424. 1895.

PILGER, R. *Ueber* Chamaeraphis *R.Br.* Notizbl. Bot. Gart. Berlin-Dahlem **10:** 207–210. 1928.

SCHLECHTENDAL, D. F. L. VON. *Ueber* Setaria *P. B.* Linnaea **31:** 420–421, 747. 1861–1862.

SOHNS, E. R. *Floral morphology of* Cenchrus, Pennisetum, Setaria *and* Ixophorus. Thesis (Ph.D.), Indiana University, 1949.

TRINIUS, C. B. *Panicearum Genera.* Mém. Acad. St. Pétersbourg VI. Sci. Nat. **1:** 217. 1834.

VASEY, GEORGE. *Gramineae. In* J. N. Rose's "Report on a Collection of Plants Made in the States of Sonora and Colima, Mexico, by Edward Palmer, in the years 1890–1891." Contr. U. S. Nat. Herb. **1:** 363. 1895.

ENTOMOLOGY.—*A new species of* Climacia *from California* (*Sisyridae, Neuroptera*). HARRY P. CHANDLER, California Department of Fish and Game, Red Bluff Calif. (Communicated by Ashley B. Gurney.)

The Sisyridae are small Neuroptera which are parasites in their larval stage on freshwater sponges. Though widely distributed in North America, especially in the eastern half of the United States, they are frequently localized and are poorly known even to most entomologists. The species here described constitutes the only record of the family Sisyridae from California that is known to the author, and this is the first time the genus *Climacia* has been recorded west of the Rocky Mountains.

Climacia californica, n. sp.

Holotype (male): Head, antennae, and palpi dark brown with margins of face paler; thorax dark brown with medial portion paler; legs light yellow; abdomen dark brown. Ultimate segment of maxillary palpi (Fig. 1, A) slightly swollen, widest near middle, outer side straight, inner side uniformly tapering to lanceolate point. Forewing; length 4 mm, width 1.3 mm, membrane clear with brown markings, much as in *C. areolaris* but less intense; wing bristles more pronounced; a brown patch extending from base of wing between Sc and MA to proximal third of wing, then faintly to posterior margin and back through anal region to base of wing; another triangular patch extending from two costal veinlets on each side of base of pterostigma to about middle of wing; pterostigma hyaline; tip of wing with light brown colored area extending from outer fourth of pterostigma which is darker, in an oblique concave arc to posterior margin at basal two-fifths, the posterior marginal area faintly broken into two spots by pale areas near end of Cul and MP2. Cell R1 between second and third cross vein not more than twice as long as wide, third cross vein proximal to junction of R1 with pterostigma; second cross vein between R4-5 and MA distal to fork in MA; third apparent cross vein between MA and MP1-2 proximal to forking of the latter; MP1-2 with third fork vein originating nearer fourth than second. Hindwings; length 3.5 mm, width 1.2 mm; color pattern about as in front wings but much fainter except in area of pterostigma. Abdomen; (Fig. 1, D), tenth tergite forming a band of nearly uniform width which, when viewed posteriorly, resembles an inverted V with apex slightly rounded, narrowly divided dorsally, lower margins slightly produced posteroventrally; tenth sternite joined at a sharp angle to inner edge of posterior margin of tenth tergite, the upper third at right angles to tergite, twisting anteriorly below so that lower third, which is about twice as wide, joins the tergite at a 45° angle; covered with coarse papillae, each bearing a bristle; ninth sternite without projecting processes.

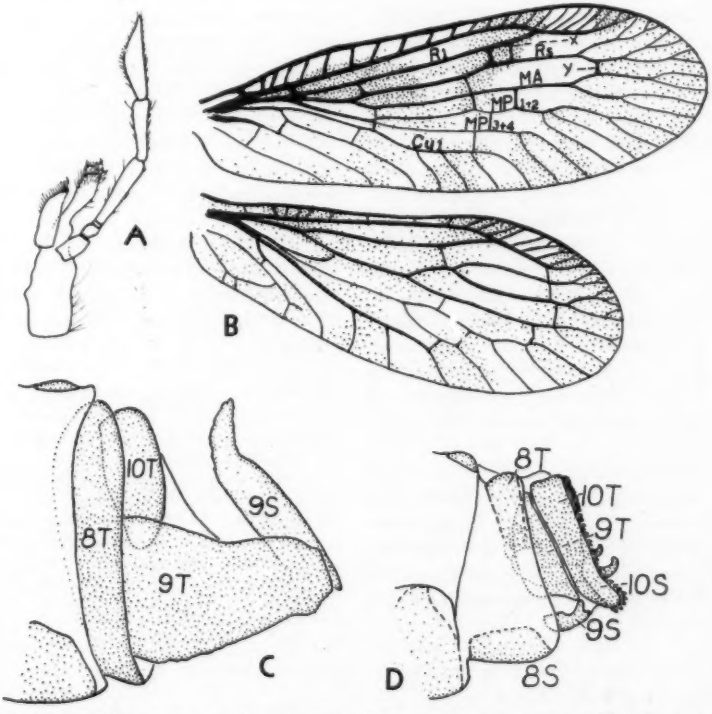


FIG. 1.—*Climacia california*, n. sp.: A, maxillae; B, wings; C, female genitalia; D, male genitalia.

Allotype (female): Forewing 5.2 by 1.7 mm; hind wing 4.5 by 1.7 mm. Genitalia (Fig. 1, C), ninth tergite with dorsal margin depressed to middle; ninth sternite parallel sided to upper third, than narrowed and bent posteriorly; tenth tergite horseshoe-shaped, posterior margin rounded and covered with bristles so that in lateral view it looks like a bristly pad.

Holotype (male): Clear Lake, Lake County, Calif., May 19, 1949, elevation 1,318 feet, H. P. Chandler. Allotype, same collection data. Paratypes, same collection data, 27 mounted specimens (16 males and 11 females) plus several in alcohol. Holotype, allotype, and three paratypes will be placed in the collection of the California Academy of Sciences, and two paratypes each in the U. S. National Museum, the Museum of Comparative Zoology, the Harley P. Brown collection, and the collection of the California Insect Survey.

The males are smaller than the females, head and body often with more yellow, the wings tend to be less densely colored and with colored area more restricted as in typical *C. areolaris*. This species may be separated from *C. areolaris* as redescribed and figured by Carpenter (pp. 255–256) and as figured by Brown (pp. 152–153) by the location of the cross veins mentioned in the description above, especially the third cross vein in cell R, and the third in cell MA (fig. 1, B, *x*, *y*); the parallel-sided ninth sternite; and the absence of a notch on the dorsal margin of the ninth tergite in the female; the sharp edged and concave posterior face of the male genitalia formed by the tenth sternites. The first branch of MP1-2 is never angular at its base, resembling a cross vein. The eyes are noticeably smaller and the antennae less robust than in the specimen figured by Brown. The number of branches of Cu reaching the margin was variable; 80 percent of the males had four and 82 percent of the females had five; none had more than five, and two males had only three.

The third instar larva resembles the larva figured by Brown (p. 146). The following exceptions are noted: The antennae have 14 segments instead of 16, the third of which is three times as long as any other segment instead of two times. The posterior bristles on the abdomen extend the width of four segments past the tip of the abdomen instead of being about even with the tip. The "neck" area is more pronounced and the pronotum more elongate.

The existence of this species was first suspected by the author while sorting Trichoptera in the California Academy of Sciences. A specimen damaged by dermestids with only the thorax and wings remaining was found among the Trichoptera. It had been taken in a light trap at Clear Lake. Several trips were made to Clear Lake to find more specimens during 1946 and 1947. A number of larvae were taken on fresh-water sponges at Rocky Point, but no adults were ever taken. In 1949 between May 16 and 19 the author made a survey of the insect fauna of this lake for the California Department of Fish and Game for the purpose of learning something about the existing fauna before this 43,000 acre lake was treated with TDE under the direction of the U. S. Bureau of Entomology and Plant Quarantine to eliminate the Clear Lake gnat (*Chaoborus astictopus* D. & S.). On the fourth and last day of this survey a determined effort was made to locate adults of this species. The site selected was near Jago's resort at the south end of the lake where the waves from the prevailing wind beat against the boulders on a rocky point. The author rowed across Jago Bay to the point. The first swing of the net in the bushes above the rocks produced an adult specimen. Pupae and parasites were taken in protected areas on the rocks above water and larvae from sponges on the rocks below the water surface. The author has not visited this site since the lake was treated with TDE, but larvae have been taken from sponges at Rocky Point since then. Apparently the species was not destroyed.

REFERENCES CITED

BROWN, HARLEY P. *The life history of* Climacia areolaris *(Hagen), a neuropterous parasite of fresh water sponges*. Amer. Midl. Nat. **47** (1): 130–160, 16 figs. 1952.

CARPENTER, F. M. *A revision of the Nearctic Hemerobiidae, Berothidae, Sisyridae, Polystoechotidae, and Dilaridae*. Proc. Amer. Acad. Arts and Sci. **74** (7): 193–280, 75 figs., 3 pls. 1940.

ENTOMOLOGY.—*The ant larvae of the myrmicine tribes Melissotarsini, Metaponini, Myrmicariini, and Cardiocondylini.*[1] GEORGE C. WHEELER and JEANETTE WHEELER, University of North Dakota. (Communicated by C. F. W. Muesebeck.)

The four small tribes treated herein have little in common except that they are all in the formicid subfamily Myrmicinae; that they are all aberrant and highly specialized; and that their affinities are most obscure.

Tribe MELISSOTARSINI Emery

This highly aberrant tribe comprises only six species in two genera—*Melissotarsus* from Africa and Madagascar and the Indomalayan *Rhopalomastix*. Emery (1921/22, p. 8) regarded them as very primitive but very profoundly adapted to particular conditions of existence. According to Wheeler (1929, Psyche **36**: 100) they are probably the last survivors of some very ancient myrmicine stock.

We find the larva of *Rhopalomastix* to be quite aberrant among the Myrmicinae but not notably specialized.

Genus **Rhopalomastix** Forel

Moderately slender. Diameter nearly uniform throughout, slightly constricted between the first and second abdominal somites. Slightly curved ventrally; dorsal profile evenly convex; ventral profile angulate between the first and second abdominal somites, otherwise nearly straight. Anterior end broadly rounded. Posterior end with a conspicuous dorsal knob projecting posteriorly. Spiracles minute and uniform. Head protruding from the ventral surface near the anterior end. Body hairs of three types: (1) Generally distributed, short, slightly curved, with short-branched tip; (2) very long, flexible, with short-bifid tip, restricted to the lateral surfaces, most numerous on prothorax, diminishing posteriorly; (3) a few minute simple spikes on the ninth and tenth abdominal somites. Cranium quadrate, with the corners rounded; front bulging enormously. Antennae with two sensilla each. Anterior surface of labrum with 10—12 hairs which are as large as those on the head; posterior surface with only a few spinules. Mandibles feebly sclerotized, except the teeth which are heavily sclerotized; proximal medial tooth very stout; no spinules. Maxillae with the apex short-subconical and directed medially; palp a small low elevation bearing three sensilla; galea consisting of two small contiguous cones, each bearing an apical sensillum. Labium small and hairy. No spinules on the hypopharynx.

Rhopalomastix rothneyi Forel
Figs. 13–20

Moderately slender. Diameter nearly uniform throughout, greatest at the fifth abdominal somite, slightly constricted between the first and second abdominal somites. Slightly curved ventrally; dorsal profile evenly convex; ventral profile angulate between the first and second abdominal somites, otherwise nearly straight. Anterior end broadly rounded. Posterior end with a conspicuous dorsal knob projecting posteriorly; anus posterior, immediately beneath the knob. Ventral surface slightly flattened (but still convex), bordered on each side by a lateral longitudinal welt. Head protruding from the ventral surface near the anterior end. Anterior end formed from the dorsal surface of the prothorax. Leg vestiges present. Spiracles minute. Body hairs moderately numerous. Of three types: (1) Generally distributed, short (0.036–0.072 mm), slightly curved, with a short-branched tip; (2) very long (0.14–0.31 mm), flexible, with short-bifid tip, restricted to the lateral surfaces, most numerous on the prothorax, diminishing posteriorly; (3) a few minute (0.001–0.002 mm) simple spikes on the ninth and tenth abdominal somites. Integument of ventral surface of thorax sparsely spinulose, the spinules rather coarse and usually isolated. Cranium quadrate, a trifle broader than long, the corners rounded; front bulging enormously. Head hairs rather numerous, short (0.018–0.036 mm), stout, with frayed tip. Antennae each with two sensilla, each of which bears a spinule. Labrum small, short, subrectangular, slightly narrowed ventrally; anterior surface with 10–12 hairs which are similar to and as large as head hairs; ventral border with six sensilla and a few isolated spinules; posterior surface with a few spinules and sensilla near the ventral border. Mandibles rather stout; teeth heavily sclerotized, otherwise feebly sclerotized; apex curved medially and forming a slender sharp-pointed tooth; first medial tooth similar to apical, proximal very

[1] The research on which this article is based was aided by a grant-in-aid from the Sigma Xi-Resa Research Fund.

stout; all teeth near the anterior surface and all pointed medially. Maxillae swollen; apex short-subconical and directed medially; spinulose, the spinules minute, stout and isolated; palp a small low elevation with three sensilla, two of which bear each a spinule, the third a conical cap; galea consisting of two small contiguous cones, each hearing an apical sensillum with its spinule. Labium small and hairy; palp small, with three spinule-bearing sensilla, two of which are mounted on subcones; opening of sericteries a very short transverse slit dorsal to the palps. (Material studied: 20 larvae from Singapore.)

Tribe METAPONINI Forel

Genus **Metapone** Forel

When Forel established this genus in 1911 he placed it provisionally in the Ponerinae in a special section which he called Promyrmicinae. "A year later, Emery examined *M. greeni* and its larva more critically and found that alcoholic specimens of the latter when properly softened and expanded had the usual shape of body, head and mouthparts of the Myrmicine larva and were furnished with long, serially arranged, hooked, dorsal hairs unlike any known Ponerine larvae, but like many larval Myrmicinae" (Wheeler, 1919, p. 173). Emery concluded that *Metapone* was a true myrmicine but retained the section Promyrmicinae to include the tribes Metaponini and Pseudomyrmicini. In the *Genera insectorum* (1921/22) he placed it at the beginning of the Myrmicinae. In 1919 (p. 177) Wheeler was convinced that *Metapone* was an "aberrant and highly specialized, though probably ancient genus of Myrmicinae, neither primitive nor ancestral," and placed the tribe "provisionally between Emery's Melissotarsini and his Stereomyrmicini." It is most unfortunate, therefore, that we have no larvae of this genus for study. The published figures and descriptions are inadequate, controversial and inconclusive.

Metapone greeni Forel

Forel (1911, p. 446) in the definition of his new section Promyrmicinae characterized the larvae as "extrêmement sveltes, distinctement articulées, sans tubercules, mais pourvues de longues soies, avec une tête distincte et deux long crocs chitineux ont tout à fait le facies des Ponérines." (Quoted by Emery, 1912, p. 94.) Fig. 7 showed a larva in side view.

Emery, 1912, p. 94:

Je donne ici une esquisse d'une jeune larve de *Metapone* que j'ai fait gonfler dans l'eau distillée, ce qui a fait que la cuticule s'est detachée des muscles, racornis par l'alcool, le contour de la cuticule est passablement différent de la figure de Forel qui, évidemment, a dessiné la larve dans l'alcool, c'est-à-dire ratatinée et maigrie. Dans ma figure, la larve n'est plus extraordinairement allongée et je connais nombre de larves de Myrmicines et de Camponotines qui sont aussi élancées qu'elle. La dite larve a une tête passablement grosse, mais pas plus distincte que d'ordinaire: les crocs qui font saillie dans la figure de la larve contractée par l'alcool, sont grands, mais pas excessivement, dans mon dessin.—J'ai dessiné la tête d'une larve de *Metapone* plus grande (ramollie comme il a été dit plus haut), pour montrer les parties buccales. A mon avis, cette larve n'a guère le facies d'une larve de Ponérine. Dans la larve que j'ai dessinée, les très longues soies sont disposées par rangées transversales, régulières, à la face dorsale de chaque segment et les soies des segments postérieures sont terminées en crochets (poils d'accrochage). C'est un caractère de Myrmicine plutôt que de Ponérine.

Fig. 1, a larva and its head enlarged, both in side view. (See Wheeler below.)

Emery, 1921/22, p. 20: "Larves non hypocéphales."

Wheeler, 1919, p. 173: See above under the genus. Fig. 2 (p. 180) reproduced Emery's (1912) figure.

Tribe MYRMICARIINI Forel

This tribe comprises a single genus of about 15 species. "This extraordinary genus may be recognized at once by the 7-jointed antennae of the worker and female and the unique structure of the abdomen in the male. The species are distributed over the Ethiopian, Indomalayan, and Papuan Regions but do not enter Australia. The majority of the species and the largest are Ethiopian. The large species form crater nests in the soil; some of the smaller, both in Africa and in the Orient, make small carton nests on the under side of leaves" (Wheeler, 1922, Bull. Amer. Mus. Nat. Hist. **45**: 141).

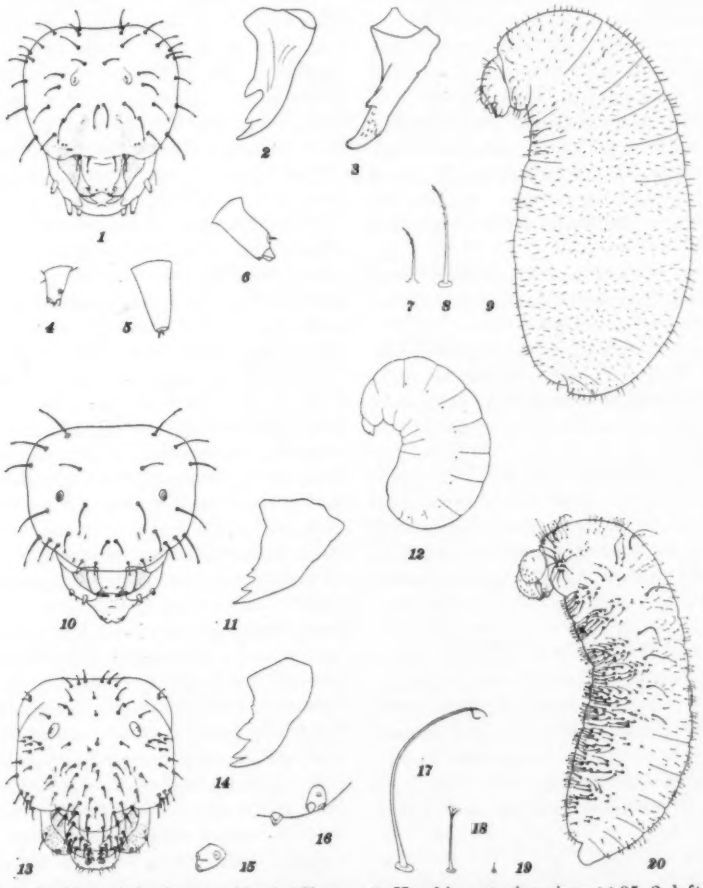
Genus **Myrmicaria** Saunders

Short and very stout; diameter greatest at the third abdominal somite, decreasing gradually toward the anterior end and more rapidly toward the posterior end which is broadly rounded. Thorax strongly arched ventrally; head on the anterior end but directed posteriorly. Dorsal profile long and C-shaped, ventral much shorter.

Spiracles small and uniform. Mouth parts small. Antennae large and drumlin-shaped. No spinules on the posterior surface of the labrum nor on the mandibles or hypopharynx. Mandibles small and short. Labium narrowed ventrally, with two small ventral knobs.

Myrmicaria eumenoides opaciventris Emery
Figs. 10–12

Short and very stout; diameter greatest at the third abdominal somite, decreasing gradually toward the anterior end and more rapidly toward the posterior end, which is broadly rounded. Thorax strongly arched ventrally; head on the anterior end but directed posteriorly. Dorsal profile long and C-shaped, ventral much shorter. Anus postero-ventral. Leg and wing vestiges present. Spiracles small. Integument furnished with minute spinules, isolated or in short rows. Head small; cranium subhexagonal in anterior view, slightly narrowed ventrally, a little broader than long. Mouth parts small. Head hairs few,



FIGS. 1–9.—*Cardiocondyla elegans uljanini* Emery: 1, Head in anterior view, × 95; 2, left mandible in anterior view, × 235; 3, left mandible in medial view, ×235; 4, left labial palp in anterior view, × 340; 5, left galea in anterior view, × 340; 6, left maxillary palp in anterior view, × 340; 7, 8, two types of body hairs, × 235; 9, larva in side view, × 32.

FIGS. 10–12.—*Myrmicaria eumenoides opaciventris* Emery: 10, Head in anterior view, × 56; 11, left mandible in anterior view, × 185; 12, larva in side view (hairs omitted), × 5.

FIGS. 13–20.—*Rhopalomastix rothneyi* Forel: 13, Head in anterior view, × 95; 14, left mandible in anterior view, × 185; 15, labial palp in anterior view, × 371; 16, ventral portion of left maxilla showing palp and galea, × 371; 17–19, three types of body hairs, × 185; 20, larva in side view, × 64.

short to moderately long (0.075–0.15 mm), stout, with denticulate tip. Antennae large, drumlin-shaped; each has three sensilla, each of which bears a spinule. Labrum small; subtrapezoidal in anterior view, narrowed ventrally; ventral border feebly impressed at the middle; anterior surface with 4–8 sensilla; ventral border with four clusters of 3–4 sensilla each; posterior surface with two clusters of three sensilla each and eight isolated sensilla. Mandibles small, short and subtriangular in anterior view, feebly sclerotized except apical teeth which are moderately sclerotized; apex forming a sharp-pointed tooth which is directed medially; two medial teeth shorter and stouter. Maxillae small, with the apex paraboloidal; palp a frustum with three apical and two subapical sensilla; galea $\bar{a}$ longer frustum with two apical sensilla. Labium narrowed ventrally, with two small ventral knobs; anterior surface spinulose, the spinules minute and in a few short arcuate rows; palp a low elevation bearing five sensilla; opening of sericteries a short transverse slit.

Sexual larva: Longer and much more voluminous; turgid. Head relatively minute. In other respects similar to worker larva.

Material studied: Eight larvae from the Belgian Congo. Since every specimen has had all or most of its body hairs broken off, we have made no attempt to describe these structures.

Myrmicaria exigua Ern. André

Eidmann, 1944, p. 445: "Die Larven sind mit hakenförmigen langen Haaren (*Oncochaeten*) dicht bedeckt, durch welche sie sich leicht zusammenballen oder auch an den Wänden der Kartonnester fest haften."

Tribe CARDIOCONDYLINI Emery

This tribe consists of two genera. *Xenometra* is known only from the female of a single species from the West Indies. *Cardiocondyla* comprises about 20 species occuring throughout tropical and warm temperate regions; the colonies are small; males are generally apterous and ergatoid.

Genus **Cardiocondyla** Emery

Plump, chunky, and subellipsoidal; head ventral near the anterior end, mounted on a stout but very short neck; ends rounded. Spiracles minute, the first slightly larger. Body hairs of one type; with the distal half denticulate. Head hairs with the tip denticulate. Labrum nearly as long as broad. Mandibles with the apex forming a rather long tooth which is curved medially and posteriorly; two stout round-pointed medial teeth (the subapical anterior and the proximal posterior) separated by a denticulate cavity. Maxillae with the apex conoidal and directed ventromedially; palp subcylindrical, with five sensilla. Labial palp a short peg, with five sensilla. No spinules on the hypopharynx.

Cardiocondyla elegans uljanini Emery
Figs. 1–9

Plump, chunky, and subellipsoidal; head ventral, near the anterior end, mounted on a stout but very short neck formed from the anterior portion of the prothorax; anterior end broadly rounded and formed from the dorsa of the prothorax and mesothorax; posterior end rounded. Anus terminal. Leg and wing vestiges present. Spiracles minute, the first slightly larger. Integument with a few short to long transverse rows of minute spinules on the ventral surface of the thorax and anterior abdominal somites and a few on the dorsal surface of the posterior abdominal somites. Body hairs short, numerous and uniformly distributed; with the apical half denticulate; most hairs lack alveolus and articular membrane and range in length from 0.045–0.063 mm; a few, however, are longer (0.054–0.09 mm) and have alveolus and articular membrane. Cranium subhexagonal in anterior view, a little broader than long and slightly narrowed ventrally. Head hairs moderately numerous, rather short (0.036–0.072 mm) with the tip denticulate. Antennae small, with three sensilla each; a minute spinule on each sensillum. Labrum nearly as long as broad, slightly narrowed dorsally, bilobed; anterior surface of each lobe with two minute hairs and/or sensilla and a few rows of minute spinules; ventral border of each lobe with one isolated and two contiguous sensilla and several minute spinules; posterior surface of each lobe with one large and three minute sensilla arranged in a sublongitudinal row; posterior surface spinulose, the middle three-fifths of the dorsal half with numerous subtransverse rows of minute spinules, fewer rows elsewhere. Mandibles moderately sclerotized, subtriangular in anterior view; apex forming a rather long tooth which is curved medially and posteriorly; two stout round-pointed medial teeth (the subapical anterior and the proximal posterior) separated by a denticulate cavity. Maxillae with the apex conoidal, directed

ventromedially and sparsely spinulose, the spinules minute and in short rows; palp subcylindrical, with four apical (two with a cap and two with a spinule) and one subapical (with a spinule) sensilla; galea a tall frustum with two apical sensilla, each bearing a spinule. Labium with the anterior surface sparsely spinulose, the spinules exceedingly minute and in short transverse rows; palp a short peg, with four apical (two with a cap and two with a spinule) and one subapical (with a spinule) sensilla; opening of sericteries a short slit on the anterior surface. (Material studied: six larvae from Turkestan.)

BIBLIOGRAPHY

EIDMANN, H. *Die Ameisenfauna von Fernando Poo.* Zool. Jahrb. (Abt. Syst.) **76:** 413–490, 1 pl., 17 text figs. 1944.

EMERY, C. *Études sur les Myrmicinae.* Ann. Soc. Ent. Belg. **56:** 94–105, 5 figs. 1912.

———. *Fam. Formicidae Subfam. Myrmicinae.* Genera insectorum, fasc. 174: 397 pp., 7 pls. 1921/22.

FOREL, A. *Sur le genre* Metapone *n. g. Nouveau groupe des formicides et sur quelques autres formes nouvelles.* Rev. Suisse Zool. **19:** 445–459, 1 pl. 1911.

WHEELER, W. M. *The ants of the genus* Metapone *Forel.* Ann. Ent. Soc. Amer. **12:** 173–191, 7 figs. 1919.

ZOOLOGY.—Valletofolliculina bicornis, *a unique new genus and species of folliculinid (Ciliata: Heterotricha) from California.* E. A. ANDREWS, Johns Hopkins University. (Communicated by Edward G. Reinhard.)

Ciliated Protozoa of the family Folliculinidae are found in the Atlantic and Pacific, north and south, living each in its own bottlelike dwelling, theca or test, but each is capable of doing away with its complicated feeding apparatus and assuming a simplified actively swimming phase. This swimming phase is of brief duration and ends in the making of a new dwelling like the former one. These tests are chitinlike and durable and present differences in size, form, and structure used to distinguish species and genera.

Some tests sent me from California represent a new species and genus as having sculpturing unlike that of any known form, of which 68 species and 28 genera are found in the great work of Hadzi (1951). These tests were very abundant on all small bivalve shells dredged April 7, 1951; but at the same place none were found in July; so it is feared these folliculinids may be nomads, as others in the Chesapeake (Andrews, 1950), and not readily found again to furnish the needed information as to how these tests originate. As yet we have only preserved tests and no information about the living animal.

DESCRIPTION

As seen in the photograph (Fig. 1), the tests stand in small groups scattered over all the inner face of bivalve shells except the border, which is clear as probably being on the ground where the shell lay inside down. Apparently there was access above at the raised umbo into the quiet water area under the shell, so that the folliculinid swimmers went in in conformity with the habit of folliculinids to settle in depressions, cavities, or circumscribed areas. In any group (Fig. 5) it is noteworthy that the tests stand radiating outward from a vague center: often two side by side or at angles to one nother, giving the impression that when parking in a group the swimmers had been influenced by each other. Each test (Figs. 2–4) has a very much elongated pear shape, lying attached most of its length as a body with rounded posterior, tapering gradually to a slender neck that rises upward, as seen in side view (Fig. 3). From the narrowest front of the neck suddenly flares out a wide funnellike mouth, suggesting a convolvulus flower. Quite unique is the presence of two ridges, like ramparts, along the right and left edges of the roof of the body of the test. These ridges converge anteriorly to dwindling points but posteriorly to swellings, each of which is produced as a horn that rises upward and outward. The two swellings and horns are generally not opposite, but either the right one or the left one is nearer the hind end of the test. It is to be emphasized that the horns and the ridges are not solid, but hollow, each being a space covered with membrane as is the main dwelling space. Thus there are five separated cavities: the main dwelling cavity, the two of

FIGS. 1–3.—Photographs of tests of *Valletofolliculina bicornis*; n. gen., n. sp., by John Spurbeck: 1, Inner face of isolated shell of a small bivalve, thickset with tests, in scattered groups (some vague rounded objects are *Cyanea scyphistomas*); 2, top view of ceramic model of a test; 3, side view of another model of a second specimen.

the ridges, and the two of the horns. The roof of the dwelling space cuts it off from both ridge spaces, and the membrane of each ridge space cuts it off from the cavity of its horn.

In paraffine sections each horn has a somewhat pyramidal base continued as a long tapering cylinder, ending abruptly as if truncated, with small rounded end that seems roughened under low powers but under immersion lens presents 20 to 30 projecting hollow spines estimated as 20 to 50 mu long, of uniform, more than one mu diameter, as if tubular outgrowths of the membrane covering the horn and open at each end.

As seen in Figs. 2–4, the colletoderm or cement that fixes the test to the substratum is wide and well defined, forming a halo about the test body as seen from above. When it and the test are scraped off from the substratum together, its width brings it to a horizontal position of rest even in such viscid mounting media as "permount" of the Fisher Scientific Co. of New York; hence side views of the tests are difficult to obtain, though tests on vertical parts of shells (as on left of Fig. 1) show side views. In cross section (Fig. 6) the cement runs far out right and left beyond the floor it forms for the test; hence when the test is removed from the cement, as in Fig. 7, there is a long narrow vacancy ending sharply in front representing the floor of the test. The boundary of this space is comparable to the "water line" of ship building which runs toward a point under the bows. Note in Fig. 6 that while a hollow ridge is cut on the left a swelling and horn are cut on the right, as being nearer to the posterior end of the ridge.

The tests are large enough to be plainly seen on a white background, Fig. 1, and yield the following measurements, in mu. Fifty tests ranged from 550 to 795, with average of 635; however, these were measured straight from mouth to hind end and hence somewhat less than whole length if measured on the side along the horizontal body and uprising neck. Forty-six tests gave body widths of 106–265, with average of 198. Fifty-one specimens had neck widths 90–116, average 101. Forty-two specimens gave mouth widths of 148–212, with average 179: thus often twice as wide as the neck just below it. When side views are obtained it is evident that here, as in many folliculinids, the test is somewhat flattened, the depth being less than the width. With the above average body width of 198, three depths were 104, 125, and 206; and for the above neck width average of 101, three measurements of depths were 78, 90, and 100. The body dwindles forward not only in width but also in depth; one was 125 deep posteriorly but only 100 anteriorly, where becoming the neck.

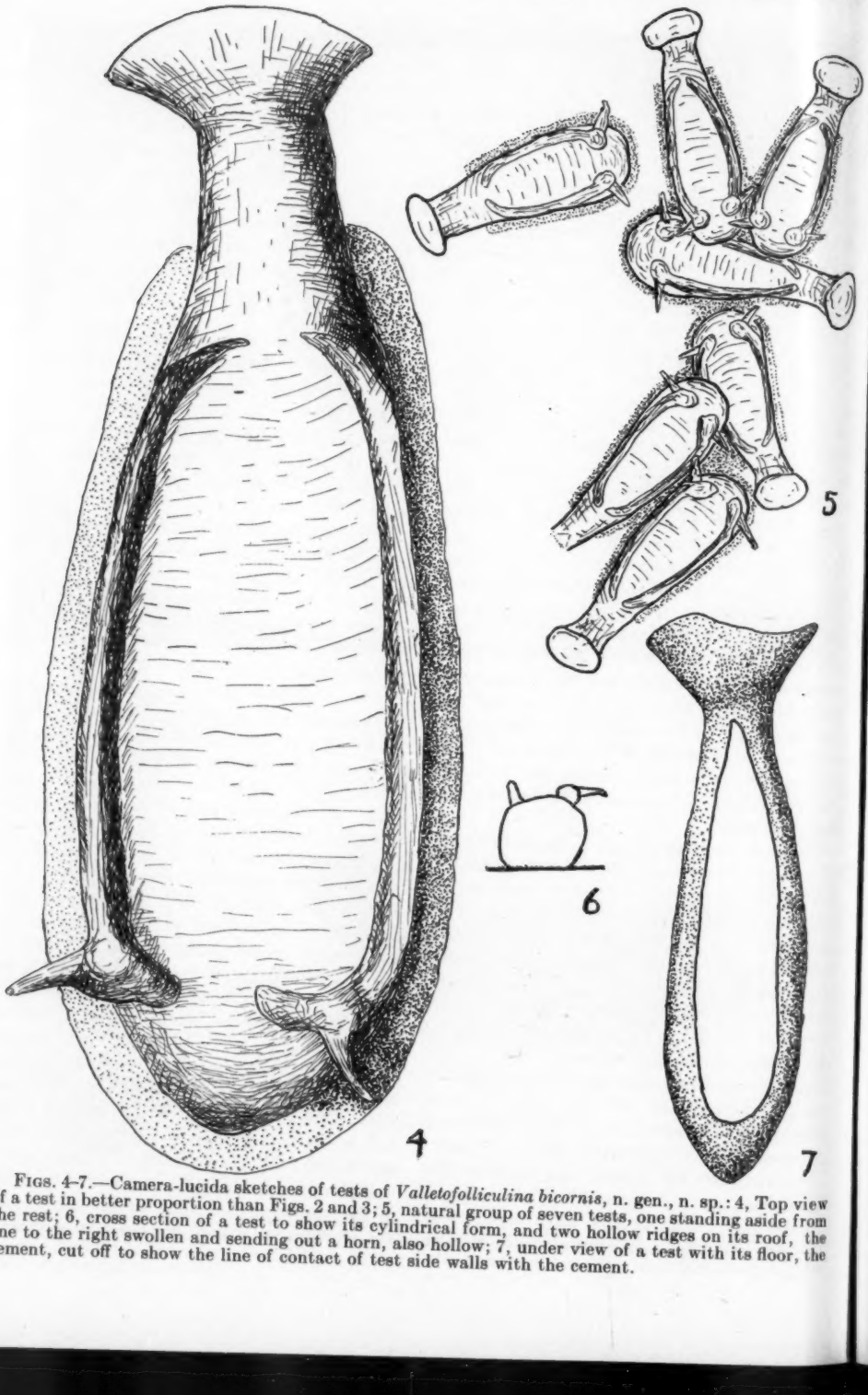
Some other measurements follow. The cement stands out beyond the test as seen from above, like a halo 20 to 78 wide. The ridges are 10–78 in height. The anterior tips of the ridges are 88–120 apart, leaving about 20 spaces from the edge of the body. The horns range from 75 to 125 in length and may be quite unequal, as 78 on the left and 125 on the right. Their tips stand 100–150 apart.

The meganucleus is spheroidal and measured 52, 56, 60, and 60 in diameter of four specimens; over it the color stripes were about 5 mu apart. The food vacuoles are generally anterior to the nucleus; some few were in the peristomial lobes. In one specimen a large object 35 mu long was going into the oesophagus, which was 85 from the tip of the lobes.

The dark green of the animal is lighter in the test where the ridges are rather red-brown, while both cement and horns are colorless.

This new folliculinid from California has considerable resemblance to one called *Parafolliculina roestensis* by Dons, who (1931) dredged it on shells in similar latitudes of the west coast of Norway; both have wide halos of cement about long pear-shaped recumbent tests with short necks ending in wide flaring mouths, and photographs of both show like clustering in small colonies. But Dons makes no mention of dorsal ridges, yet speaks of a local thickening of 40 mu in position corresponding to one of the posterior swellings of the new species, a resemblance increased by the occurrence of an abnormality in one of our specimens in which one ridge bore two blunt elevations in place of the usual swelling and horn. However, Dons' species had a characteristic median pouch from the main cavity at the foot end and two valves that were right and left plates, a feature not found in any other folliculinid. The California specimens looked so much like Dons' figures we expected to see lateral valves and for a time so interpreted the sides of the neck rising from the cement! Some future observations may decide if possibly Dons was misled as to the presence of lateral valves!

Hollow dorsal ridges along the roof of the body of the test being something known only in this new Californian species, we deem it of generic



FIGS. 4–7.—Camera-lucida sketches of tests of *Valletofolliculina bicornis*, n. gen., n. sp.: 4, Top view of a test in better proportion than Figs. 2 and 3; 5, natural group of seven tests, one standing aside from the rest; 6, cross section of a test to show its cylindrical form, and two hollow ridges on its roof, the one to the right swollen and sending out a horn, also hollow; 7, under view of a test with its floor, the cement, cut off to show the line of contact of test side walls with the cement.

value; and as the two ridges converge both anteriorly and posteriorly they tend to circumscribe a dorsal area as if by walls, and so we devise the generic name **Valletofolliculina** for this genus and the name **bicornis** for this species.

Its chief characters are: Hollow dorsal ridges prolonged as hollow horns with complex ending; wide flaring mouth from very narrow end of short uprising neck; long pear-shaped reclining body; wide cement; no internal valves; and meganucleus of one lobe.

The posterior end of the test does not show a pit as Dons found, and as far as preserved specimens reveal the tail end of the animal is rounded and often broken loose from the test.

Dredged April 7, 1951, 8–10 feet, 30 per cent salinity in Tomales Bay, Calif., on inner face of bivalve shells, 1 inch and less in length. Tests scattered in groups of up to seven.

DISCUSSION

The chief architectural effects produced by folliculinids result, as in human habitations, from the placement and form of cavities and their walls, and not from solid masses as in crystal aggregates.

As far as known, all skeletal structures in folliculinids arise from the outer surfaces of active protoplasm, by secretion and accompanying activity of cilia. Here ciliary activity accompanies secretion as in many metazoa, notably molluscs and vertebrates. But having made superficial skeletal structures, cement, tests, valves, etc., the protoplasm *retires* and leaves the secreted exoskeleton to permanently represent the former outline and location of the active protoplasm. Even the spiral ridges on the necks of many kinds of folliculinid tests are not simple solids but made up of layers, as long since recognized by Wright (1859), and arise from special ciliary and secretion activities (Andrews, 1923; Das, 1947).

Some of the marked architectural effects caused by cavities and their walls in folliculinids are the following: Many have front halls or atria which in *Parafolliculina* often have side alcoves; the genus *Pebrilla* has the dwelling cavity marked off into anterior and posterior rooms by an external construction, which is not made by outside compulsion but, as Fauré-Fremiet saw (1936), by special action of the swimming phase, in constructing first the posterior chamber and later adding an anterior room. There may be also median posterior outpushings of the main chamber as seen in *Pebrilla*, in the above *Parafolliculina roestensis*, and as a long tubular affair in the upstanding stalked *Pseudofolliculina mellita* (Laackmann) (Dons, 1927) from deep Antarctic waters. Test walls may show numerous outpushings or subordinate chambers as seen by Silen (1947) in some *Folliculina gigantea* if crowded against others, with pouches on each side of an obstacle, and Dons (1927) figures some individuals of *Lagotia simplex* with side alcoves from the test bodies; finally, in the remarkable *Mirofolliculina limnoriae* (Giard) (Dons, 1927) many and variable pouches from the main chamber become a generic character. These folliculinids settle upon rough surfaces of the outside of the wood-boring isopod *Limnoria*, and Fauré-Fremiet thought the pouches were formed by the secretions of the artificer flowing out about obstructing roughnesses, hairs, of the substrate. We note that the protoplasm that makes these pouch walls may remain anchored to the bottom of each pouch as in one figure of Fauré-Fremiet, or it may withdraw as in another figure and as represented by Giard. In many specimens of this species sent me from Friday Harbor, Wash., by Dr. John Buck there are many instances of such withdrawals of plasma from former secretions; and many show the pouches not all on one level, but posteriorly and laterally, below and above, as if the test had "broken out" in pustules, suggesting to me that obstacles to outflow of the plasm in test making cause a general irritation that results in pouch formation far from the points of contact.

With the above facts in mind, we have only to assume the test-making phase of *Valletofolliculina bicornis* has special protoplasmic dorsal ridges; to modify what is known of test making in some other folliculinids and postulate, the test is made as follows. The swimming phase, after gliding over a suitable building site, relaxes as if a mere drop wetting the substrate and then secretes over the part of the substrate it covers the attaching cement, whose form and size will record the form and size of the animal at that period; next it resumes a cylindrical form but with two protoplasmic ridges along its upper face, each of which projects as a hornlike pseudopod ending with some filose activity suggesting the anchoring organs of stentor (Andrews, 1945) but yet not forming the real anchoring organ. This protoplasmic cylinder with ridges then se-

cretes the covering of chitin-like exoskeleton that will remain as the record of the form and position the protoplasm then had. The tips of the pseudopods appear to act somewhat as in forming a scopula, as found in vorticellids as made out by Fauré-Fremiet (1905); the rest of the pseudopod secretes the walls of the horns and then retires into the mass of the ridges. As the ridges secrete their covering it cuts them off from the cavities of the horns, and later when the entire cylinder forms its secreted covering it cuts off the dwelling cavity from the cavities in the ridges from which the plasm retreats into the main mass of the cylinder.

No uses are known for the ridges or the horns. Possibly the ridges might give some protection against the rasping effect of some wandering gastropod's horny teeth. Conceivably the filose activity at the tips of the pseudopods might have some sensory part to play in parking of tests in groups!

LITERATURE CITED

ANDREWS, E. A. Folliculina: *Case making, anatomy and transformation*. Journ. Morph. **38:** 207–278. 1923.

———. *Stentor's anchoring organs*. Journ. Morph. **77:** 219–232. 1945.

———. *Folliculinids of the Chesapeake as nomads*. Journ. Marine Res. **9:** 21–28. 1950.

DAS, S. M. *The biology of two species of Folliculinidae (Ciliata, Heterotricha) found at Cullercoats, etc.* Proc. Zool. Soc. London **117:** 441–456. 1947.

DONS, C. *Folliculina-Studien I–III*. Arch. Protistenk. **27:** 73–93. 1912.

———. *Neue und wenig bekannte Protozoen*. Norske Vid. Selsk. Skrifter 1927 (7): 1–17. 1927.

———. Parafolliculina röstensis *n.sp.* Norske Vid. Selsk. Forh. **3:** 173–176. 1931.

FAURÉ-FREMIET, E. *La structure de l'appareil fixateur chez les Vorticellidae*. Arch. Protistenk. **8:** 207–226. 1905.

———. *La famille des Folliculinidae (Infusoria Heterotricha)*. Mém. Mus. Hist. Nat. Belgique, ser. 2, **3:** 1129–1175. 1936.

GIARD, A. *Fragments biologiques XIII. Sur les genres* Folliculina *et* Pebrilla. Bull. Sci. France et Belgique, ser. 3, **1:** Paris, 1888.

HADZI, J. *Studien ueber Folliculiniden*. Academia scientiarium et artium slovenica. Institutum biologiae **2:** 1–390. Ljubljana, Yugoslavia, 1951.

LAACKMANN, H. *Zur Kenntnis der heterotrichen Infusorien gattung* Folliculina *Lamarck*. Deutsche Südpolar Expedition, 1901–1903, 12, Zool. **4:** 77–89. 1910.

SILÉN, LARS. *On Folliculinidae (Ciliophora Heterotricha) from the west coast of Sweden*. Ark. Zool. **39A** (12): 1–68. 1947.

WRIGHT, T. S. 1859. *Description of new Protozoa*. Edinburgh New Philos. Journ. **10:** 97–104. 1859.

ZOOLOGY.—*A new cyprid ostracod from Maryland.*[1] EDWARD FERGUSON, JR.,[2] Orangeburg, S. C. (Communicated by Willis L. Tressler.)

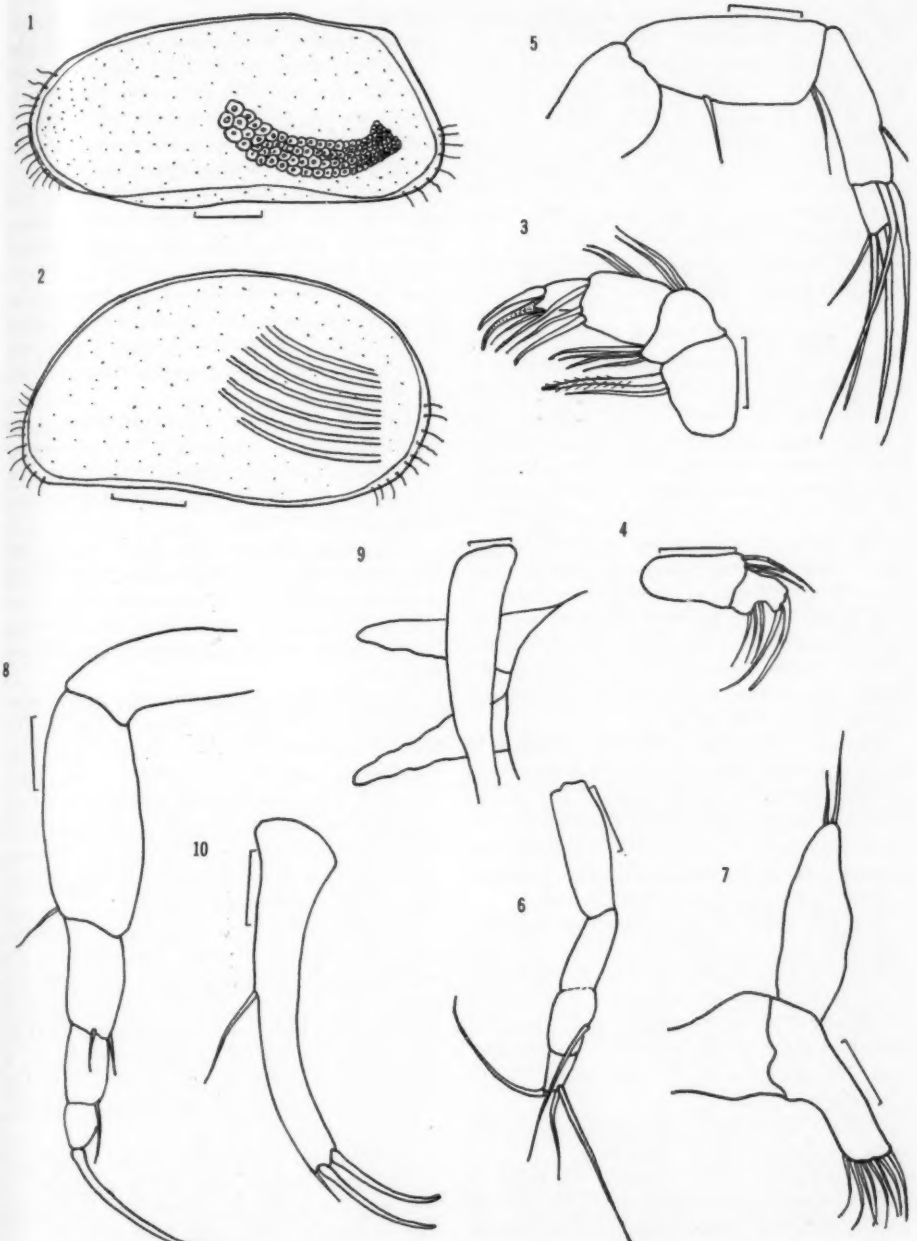
Two females and one male ostracod belonging to a new species of the genus *Candona* were collected during January 1951 from a drainage ditch on Eldon Hall farm near Princess Anne (Somerset County) Md. This paper describes the new species *Candona hoffi*, named in recognition of C. Clayton Hoff, an outstanding contemporary investigator of American fresh-water Ostracoda.

Genus **Candona** Baird, 1845

The valves of members of this genus are white, sometimes transparent, occasionally with a mother-of-pearl sheen. The surface of the valves is smooth, sometimes with hairs. The shape of the shell varies, generally elongated ovoid to reniform and in some representatives the dorsal margin is straight and the ends are truncate. The swimming setae of the antennae are absent; the antenna of the female has five podomeres, and that of the male has six podomeres that result from the division of the penultimate podomere. The penultimate and ultimate podomeres of the mandibular palp are short and rounded. The respiratory plate of the first thoracic appendage is rudimentary, usually provided with two unequal setae, and never with more than three setae. The third thoracic appendage, which frequently has four podomeres, sometimes appears to consist of five podomeres through a division of the penultimate podomere. The terminal podomere of the third thoracic appendage is short and bears two backwardly directed setae. The furcal ramus is exceptionally well developed and bears two strong claws and one or two setae.

[1] A contribution from the Department of Biology of the State A. and M. College, Orangeburg, S. C.

[2] Appreciation is expressed to Dr. Willis L. Tressler, of the United States Navy Hydrographic Office, for his aid in the preparation of the drawings.



FIGS. 1–10.—*Candona hoffi*, n. sp.: 1, Lateral view of left valve of female holotype; 2, lateral view of left valve of male paratype; 3, mandibular palp of female paratype; 4, maxillary palp of female holotype; 5, left antenna of female paratype; 6, third thoracic appendage of female holotype; 7, first thoracic appendage of female holotype; 8, second thoracic appendage of female paratype; 9, genital lobes and proximal end of furca of female paratype; 10, left furca of female paratype. (All drawings were made with the aid of a camera lucida from specimens stained with acid fuchsin and mounted in Canada balsam. The scale in Figs. 1 and 2 equals 0.20 mm; the scale in Figs. 3–10 equals 0.40 mm.)

The genus *Candona* has not previously been reported from the State of Maryland. Forty-one species of the genus have been reported from North America; of this number 27 species have type localities in the United States. Turner (1894, 1895) described three species, two from Georgia and one from Delaware. Sharpe (1897) described three species from Illinois. Furtos (1933) reported 12 new species from Ohio; Dobbin (1941) described one new species from the State of Washington, and Hoff (1942) reported eight new species from Illinois.

Candona hoffi, n. sp.

Shell.—From the lateral view the left valve of the female (Fig. 1) has a rounded anterior margin and an almost straight-dorsal margin. The posterior margin is truncate, and projects slightly at the postero-ventral angle. The ventral margin has a slight sinuation near the center. A few hairs are present along the anterior border, and also on the ventral margin of the posterior border. The surface of the valve is smooth; numerous irregularly shaped dots are seen in valves stained with a 0.5 percent aqueous acid fuchsin. The shell is widest at or near the center, with the greatest width approximately one-half of the length. The ovaries are located in the postero-ventral region of the valve.

The left valve of the male (Fig. 2) differs in shape from that of the female. The anterior and posterior margins are both rounded. The ventral margin is slightly sinuate near the anterior end; the dorsal margin is convex. Hairs and irregularly shaped dots as in the female. The testes are situated in the posterior part of the shell.

The left valve of the single male specimen measured approximately 1.17 mm in length and 0.74 mm in height. The left valve of the female holotype measured approximately 1.10 mm in length and 0.52 mm in height. The permanent mount of the male specimen was broken accidentally, consequently all descriptions of the appendages are from females.

Cephalic appendages.—The antennules do not show any distinct specific characters.

The antennae have five podomeres; natatory setae are absent. The terminal end of the ultimate and the distal end of the penultimate podomeres each with a spine-like seta (Fig. 5). The sense organ is situated near the proximal end of the antepenultimate podomere.

The mandibular palp (Fig. 3) is composed of four podomeres; the terminal podomere is oval with its greatest width equal to the length. The distal end of the dorsal margin of the penultimate podomere is armed with three setae; the ultimate podomere has two strong terminal spines. A bundle of four setae is situated on the inner margin of the antepenultimate podomere.

The maxilla is composed of three lobes. The maxillary palp (Fig. 4) is formed of two podomeres; the proximal one bears three terminal setae on its dorsal, distal margin. The distal podomere is approximately one-half the length of the proximal one, and bears on its ventral margin three setae of approximately equal length; two spinelike setae are situated on the free end of the distal podomere.

Thoracic appendages.—The first thoracic appendage (Fig. 7) is composed of two podomeres; one podomere is perpendicular to the other. The free end of the vertical podomere bears two unequal respiratory setae.

The second thoracic appendage (Fig. 8) has five podomeres. The antepenultimate podomere is slightly longer than the penultimate one. The second podomere is longer than the combined lengths of the antepenultimate and penultimate podomeres.

The third thoracic appendage bears five podomeres, four of which are shown in Fig. 6. The five podomeres result from the division of the long penultimate podomere. Located on the distal one-third of the penultimate podomere is a long seta that extends well beyond the terminal part of the ultimate podomere. The ultimate podomere bears two long terminal setae of approximately equal length and oppositely directed.

The furca.—The furca (Fig. 10) is well developed and distinctly curved. The length of the ventral margin is approximately 10 times the least width of the ramus. The dorsal seta has a length approximately 3 times the least width of the ramus. The length of the terminal seta is approximately 12 times its least width. The furca has two strong terminal spines of approximately equal length.

Reproductive organs.—The ovaries are located in the postero-ventral region of the valve (Fig. 1). The genital lobe (Fig. 9) is bifurcated; the ventral lobe is slightly longer and more pointed than the dorsal. The lobes project posteriorly between the furcal rami.

Remarks.—The structure of the genital lobes and the bundle of 4 setae on the antepenultimate

podomere of the mandibular palp in *C. hoffi* are diagnostic characters of the Acuminata group. The new species resembles *C. acuta* Hoff, 1942, very closely; however, the two species may be readily distinguished by the structural differences of the reproductive organs. Hoff (1942) describes the ovary of *C. acuta* thus: "The ovary appears as a narrow band, posteriorly much more narrowed than in most Candona." The ovary of *C. hoffi* forms a relatively wide band of uniform width over its entire length. In *C. acuta* the genital lobe as shown by Hoff (1942: fig. 69) is a single rounded structure barely reaching beyond the dorsal ramus of the furca. The genital lobe in *C. hoffi* is bifurcated; the ventral lobe is longer and more pointed than the dorsal. Both lobes extend well beyond the dorsal ramus of the furca.

Type locality.—The type specimens were collected on January 11 and 25, 1951 from a drainage ditch on Eldon Hall farm near Princess Anne (Somerset County) Maryland. The temperature of the air and water was 0 degrees Centigrade on January 25; collections on this date were made from water covered by a thin sheet of ice. The muddy water that was always present also served as the habitat for green algae of several kinds, for numerous rotifers, and for the ostracod *Cypridopsis vidua.*

Type specimens.—The two stained permanent mounts of dissected specimens from which the description of the new species reported in this paper was made have been deposited in the U. S. National Museum, nos. 93561 and 93562.

LITERATURE CITED

DOBBIN, CATHERINE N. *Fresh-water Ostracoda from Washington and other western localities.* Univ. Washington Publ. Biol. **4:** 174–246. 1941.

FURTOS, NORMA C. *Ostracoda of Ohio.* Ohio Biol. Surv. **5:** 411–524. 1933.

HOFF, C. CLAYTON. *Ostracoda of Illinois, their biology and taxonomy.* Illinois Biol. Monogr. **19:** 1–196. 1942.

SHARPE, RICHARD W. *Contribution to a knowledge of the North American fresh-water Ostracoda included in the families Cytheridae and Cyprididae.* Bull. Illinois Lab. Nat. Hist. **4:** 414–484. 1897.

TURNER, CHARLES H. *Notes on American Ostracoda, with descriptions of new species.* Bull. Sci. Lab. Denison Univ. **8:** 13–26. 1894.

———. *Fresh-water Ostracoda of the United States.* 2d Rep. State Zoologist Minnesota: 277–337. 1895.

MAMMALOGY.—*Three new lemmings* (Dicrostonyx) *from Arctic America.*

CHARLES O. HANDLEY, JR., United States National Museum.

A revisionary study of the varying or collared lemmings of the genus *Dicrostonyx* has shown that three American populations differ from known races by well-marked distinguishing characters and should be recognized by name. I am indebted to the American Museum of Natural History, the Harvard University Museum of Comparative Zoology, the National Museum of Canada, and the University of California Museum of Vertebrate Zoology for the loan of comparative material. In the following discussions, specimens from these museums are indicated by the abbreviations AMNH, MCZ, NMC, and MVZ, respectively, and those from the United States National Museum, including the Biological Surveys Collection, by US. I am particularly grateful to the National Museum of Canada and the U. S. Fish and Wildlife Service for the privilege of designating specimens from the collections in their care as types. Capitalized color terms are from Ridgway, 1912, *Color standards and color nomenclature.* All measurements are in millimeters and are given as averages followed by extremes.

Dicrostonyx groenlandicus clarus, n. subsp.

Type.—U. S. N. M. no. 290952; old adult male, skin and skull; collected June 16, 1949, by Charles O. Handley, Jr.; near sea-level at Cherie Bay, 5.4 miles ENE. of Mould Bay Station, Prince Patrick Island, District of Franklin, Northwest Territories, Canada (lat. 76° 19′ N., long. 119° 02′ W.); collector's number 1285.

Distribution.—The Parry Islands of the Canadian Arctic Archipelago. Specimens are available only from Melville, Prince Patrick, and South Borden Islands, but the range probably includes also Ellef Ringnes Island, the Bathurst Islands, and other smaller islands of this general area. Zonal range: Arctic.

Description.—Adult summer coloration: Mass effect bright gray above; dorsum, except for lighter areas on shoulders, rather uniformly colored from snout to tail; light band on dorsal

hairs typically pure white; subapical orange band on dorsal hairs narrow or absent and contributing little to mass color effect; orange of sides typically invading dorsum in shoulder region only slightly; faint but readily discernible black median dorsal stripe extending from snout to base of tail; rump gray; ear patches between Sanford's Brown and Amber Brown; tail and feet whitish; belly washed with orange ranging in hue from Pale Ochraceous-Buff to Sanford's Brown, darkest color concentrated along midline and on chest, forming an obscure collar; flanks, especially at base of fore leg, tinged with orange of same hue as belly. Juvenal summer coloration: Dorsum grayish-brown, varying with season and individual from Snuff Brown to Sudan Brown; shoulders lighter than remainder of dorsum; black median dorsal stripe well defined and extending from forehead to base of tail; underparts varying from buffy to almost white; throat collar poorly developed. Winter pelage: white. Size large; tail long. Skull large, but light and lacking extreme angularity; rostrum long and narrow; dorsal root of premaxilla narrow; maxillary part of zygoma strongly notched on anterior surface and protruded on posterior surface above infraorbital canal; supraorbital ridges of frontals generally weakly developed; postorbital process of squamosal poorly developed; zygomata light and parallel to one another in outline; temporal ridges poorly developed, but lambdoidal crest strong; brain case large; auditory bullae relatively small; molars light, triangle pattern compressed antero-posteriorly.

Measurements.—Twelve old adults, including the type, from Prince Patrick Island: Total length, 146 (140–154); tail vertebrae, 26 (23–28); hind foot, 21 (19–23); greatest length of skull, 32.4 (31.3–33.5); length of brain case (from dorsal midpoint of foramen magnum to antriormost projection of parietal), 12.9 (11.5-13.8); median length of nasals, 9.0 (8.5–9.4); greatest breadth of combined nasals, 3.8 (3.4–4.0); least interorbital breadth, 3.9 (3.6–4.2); maximum zygomatic breadth, 20.6 (19.4–21.3); breadth of brain case (at constriction behind postorbital processes of squamosals), 13.4 (13.0–13.9); alveolar length of maxillary molar row, 8.2 (8.0–8.5).

Comparisons.—Two races require comparison with *clarus*; *groenlandicus* inhabiting the islands to the eastward, and *kilangmiutak* those to the south. In adult summer coloration *clarus* resembles *groenlandicus* in having the dorsum almost clear black and white and largely lacking orange. However, the black tips of the dorsal hairs are not as long in *clarus*, and a grayer dorsal coloration results. Other characters distinguishing *clarus* are: black median dorsal stripe more pronounced; rump grayer; flanks less bright; underparts considerably paler; throat collar and median ventral stripe better defined. In juvenal summer coloration, *clarus* is darker, more brownish dorsally, and has the median dorsal stripe better defined and more extensive. The skull of *clarus* is similar in general to that of *groenlandicus*, but shows the following differences: lighter and less angular; nasals somewhat shorter; dorsal root of premaxilla narrow; supraorbital ridges less strongly developed and usually well separated; zygomata parallel-sided and not rounded in outline; brain case longer; triangle pattern of molars more compressed; auditory bullae less inflated.

From *kilangmiutak*, summer adult *clarus* differs as follows: dorsum more grayish, and lacking pinkish cast in the shoulder region; ear patches darker; orange flank color darker, less pinkish, and less extensive; orange median ventral stripe longer and better defined. In juvenal summer pelage: slightly darker dorsally; median dorsal stripe slightly better defined; throat collar less developed. The skull of *clarus* differs significantly from that of *kilangmiutak* in having much larger size, more angular and heavier construction, longer rostrum and nasals, wider nasals, less developed supraorbital ridges, more conspicuously notched zygoma (anteriorly above infraorbital canal), more parallel sided zygomata, narrower dorsal root of premaxilla, and more prominent temporal ridges.

Specimens examined.—Canada, N.W.T.: Melville Island, Liddon Gulf, 1 (NMC); Winter Harbor, 5 (US); no specific locality, 1 (NMC). Prince Patrick Island, vicinity of Mould Bay, 99 (NMC), 68 (US). South Borden Island, south coast, 1 (NMC).

Dicrostonyx groenlandicus lentus, n. subsp.

Type.—Nat. Mus. Canada no. 11404; old adult male; skin and broken skull; collected June 13, 1931, by J. Dewey Soper at Lake Harbor, Baffin Island, District of Franklin, Northwest Territories, Canada (62° 43′ N., 69° 41′ W.); collector's number 2384.

Distribution.—Approximately the southern half of Baffin Island, Northwest Territories, Canada. North at least to Nettilling Lake and

Cape Mercy; south to Hudson Strait. Zonal range: Arctic.

Description.—Adult summer coloration: Black in dorsal pelage reduced and light band on dorsal hairs pale buff, rendering mass effect between Avellaneous and Drab; black median dorsal stripe not well defined; ear patch Ochraceous-Tawny; feet and tail whitish; orange wash on flanks reduced and not extending on dorsum in shoulder region; underparts typically pale (Pale Ochraceous-Buff to almost white); throat collar and orange median ventral line pale, but well defined because of lighter background. Juvenal summer coloration: Dorsum relatively dark (Sayal Brown); shoulders scarcely differentiated from remainder of dorsum; black median dorsal line well defined; belly light buff to whitish; throat collar poorly developed. Winter pelage: white. Size small. Skull small, light, and lacking angularity; nasals long and narrow; dorsal root of premaxilla wide; anterior notch and posterior protuberance on zygoma above infraorbital canal poorly developed; supraorbital ridges strongly developed; postorbital processes of squamosal well developed; zygomata of very light construction, rounded in outline; maxillary molars small and light, triangle pattern slightly compressed anteroposteriorly.

Measurements.—Four adults (including the type) from southern Baffin Island: Total length, 129 (type only); tail, 18 (type only); hind foot, 12 (type only); greatest length of skull, 29.1 (28.6–29.2); length of brain case, 12.4 (12.4–12.5); median length of nasals, 8.6 (8.4–8.7); greatest breadth of combined nasals, 3.3 (3.1–3.4); least interorbital breadth, 3.7 (3.6–3.8); maximum zygomatic breadth, 18.3 (18.1–18.5); breadth of brain case, 12.3 (12.0–12.6); alveolar length of maxillary molar row 7.2 (6.9–7.4).

Comparisons.—In contrast to the bright *groenlandicus*, *lentus* is dorsally pale and dull in adult summer pelage, a consequence of reduction of black and replacement of white with buff on the individual hairs. It has the black median dorsal stripe better defined, and the flanks and underparts less tinted with orange. In juvenal summer pelage *lentus* is much darker brown dorsally than *groenlandicus*. Cranially, *lentus* is quite similar to *groenlandicus*, differing principally in smaller size and less angularity of the skull. In addition, it lacks the anterior notch and posterior protuberance of the zygoma above the infraorbital canal, and its molars are smaller.

In coloration *lentus* is similar to *hudsonius* but is slightly paler, duller, and more buffy on the dorsum, has a less well defined black median dorsal stripe, has the belly generally lighter and less cinnamon, has the throat collar paler and less extensive, and has a more pronounced orange median ventral line. The dorsum of the juvenal summer pelage is not so yellowish in *lentus*. With regard to the cranium, *lentus* is strikingly smaller and more fragile than *hudsonius*, and lacks angularity. Furthermore, it lacks the great development of the anterior notch and the posterior protuberance above the infraorbital canal on the zygoma, and the heavy, blunt postorbital process of *hudsonius* is replaced by a much smaller structure.

In adult summer coloration, *lentus* is quite unlike *richardsoni*, being much paler and duller in general, less brown and red on the dorsum, much paler on the underparts, and with the black median dorsal stripe poorly developed. The juvenal summer pelage in the two races is similar, except that *lentus* averages somewhat paler and usually has a less prominent black median dorsal stripe. In *lentus* the skull is smaller, somewhat lighter and less angular, the nasals are longer and narrower, and the zygomata are lighter.

Specimens examined.—Canada, NWT, BAFFIN ISLAND: Amadjuak Bay, 6 (NMC); Bowdoin Harbor (Schooner Harbor), 1 (MCZ); Bowman Bay (Camp Kungovik), 1 (NMC); Cape Dorset, 6 (NMC); Cape Mercy, 1 (US); Gordon Bay (Ikkarashuk), 1 (NMC); Lake Harbor, 6 (NMC); Nettilling Lake, 5 (NMC); "southwest coast", 3 (MCZ); "Baffin Island," 2 (MCZ).

Dicrostonyx unalascensis peninsulae, n. subsp.

Type.—U. S. N. M. (Biol. Surv. Coll.) no. 246377; old adult female; skin and skull; collected May 8, 1925, by Olaus J. Murie near sea-level at Urilla Bay, Unimak Island, Alaska; collector's number 1993.

Distribution.—Southwestern Alaska, including Unimak Island, the eastern side of the Alaska Peninsula to Chignik, and the Bering Sea coast from Isanotski Strait to Nushagak. Zonal range: Subarctic.

Description.—Adult summer coloration: Red of flanks extending prominently as a wash on dorsum; subapical orange bands of dorsal hairs wide; black tips of dorsal hairs narrow; total color effect of dorsum reddish-brown, between Tawny and Orange-Cinnamon; nape and cheeks

buffy, poorly distinguished from dorsum; ear patches about Sanford's Brown; black median dorsal stripe pronounced; feet and tail whitish; underparts between Pale Yellow-Orange and Light Buff; throat collar wide and dark, but poorly defined (about Amber Brown); well defined median ventral stripe of same color extending from collar to middle of belly. Juvenal summer coloration: Dorsum dark and bright, between Cinnamon-Brown and Dresden Brown in mass effect; cheeks and ear patches similar to remainder of dorsum; black median dorsal stripe well developed; underparts buffy, with poorly defined brownish collar. Winter pelage: At least some individuals white. Size small. Skull small, but heavy and angular in construction; nasals short and wide; zygoma not or only slightly notched anteriorly above infraorbital canal; posterior protuberance of zygoma above infraorbital canal fairly well developed; zygomata heavy and of tear-drop shape in outline, tapering posteriorly; postorbital process of squamosal large and blunt; supraorbital ridges poorly developed; temporal ridges prominent; brain case short and narrowed posteriorly; molars large and heavy; auditory bullae small and not inflated.

Measurements.—Three old adults (including type) from Unimak Island. Total length, 132 (130–133); tail vertebrae, 15 (11–18); hind foot 19 (19–19); greatest length of skull, 28.6 (28.2–28.9); length of brain case, 11.8 (11.5–12.0); median length of nasals, 8.4 (8.3–8.5); greatest breadth of combined nasals, 3.5 (3.4–3.5); least interorbital breadth, 3.8 (3.7–3.8); maximum zygomatic breadth, 18.7 (18.7–18.7); brain-case breadth, 11.7 (11.5–11.9); alveolar length of maxillary molar row 7.6 (7.3–7.9).

Comparisons.—*D. u. peninsulae* must be compared with two other populations: that represented by *D. u. unalascensis* to the south, and that inhabiting the Bering Sea coast to the north. The latter has been considered a segment of *D. groenlandicus rubricatus*, whose type locality is Bering Strait, and whose extensive range includes the arctic coasts of Alaska and Canada. However, the lemmings of the northern Bering Sea coast of Alaska are quite distinct from *rubricatus*, having the skull smaller and lighter, the nasals narrower, the supraorbital ridges stronger, and the dorsal pelage much more brownish in summer. The name *Dicrostonyx nelsoni* Merriam (type locality: St. Michael, Norton Sound, Alaska) is available for this population, which should therefore be called *Dicrostonyx groenlandicus nelsoni*.

In adult summer pelage *D. u. peninsulae* resembles *D. g. nelsoni*, but has the black in the dorsal pelage reduced; the cheeks more buffy; the black median dorsal stripe better developed; the red on the flanks less extensive; the underparts more yellowish; and the throat collar darker. The skull of *peninsulae* is smaller, heavier, and more angular; the nasals and rostrum are shorter and wider, the zygomata are heavy and tear-drop shaped rather than rounded; the postorbital process of the squamosal is larger and blunter; the temporal ridges are stronger; the braincase is shorter and narrower posteriorly; the molars are larger and heavier; and the auditory bullae are smaller and less inflated.

From *D. u. unalascensis* in summer pelage, *peninsulae* differs in having the dorsum lighter, brighter, and more reddish; the flanks more reddish; the black median dorsal stripe better defined; the belly more yellowish, and the throat collar neither so dark nor so extensive. In size, *peninsulae* is much smaller. The skulls of the two forms are almost identical except in size.

Specimens examined.—ALASKA: Chignik, Alaska Peninsula, 1 (US); Muller Bay, Alaska Peninsula, 1 (AMNH); Nushagak, 4 (US); Urilla Bay, Unimak Island, 4 (US).

o. 6

of *D.*
ty is
ludes
How-
; Sea
atus,
asals
and
amer.
(type
ka) is
here-
lsoni.
ne re-
n the
uffy;
oped;
nder-
collar
avier,
n are
y and
; the
er and
; the
y; the
litory

elage,
ghter,
e red-
better
throat
a size,
of the
a size.
nignik,
Alaska
(US);